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Digital Reading in PISA 2012 and ICT Uses: How do VET and General Education Students Perform?

Patrícia Dinis da Costa
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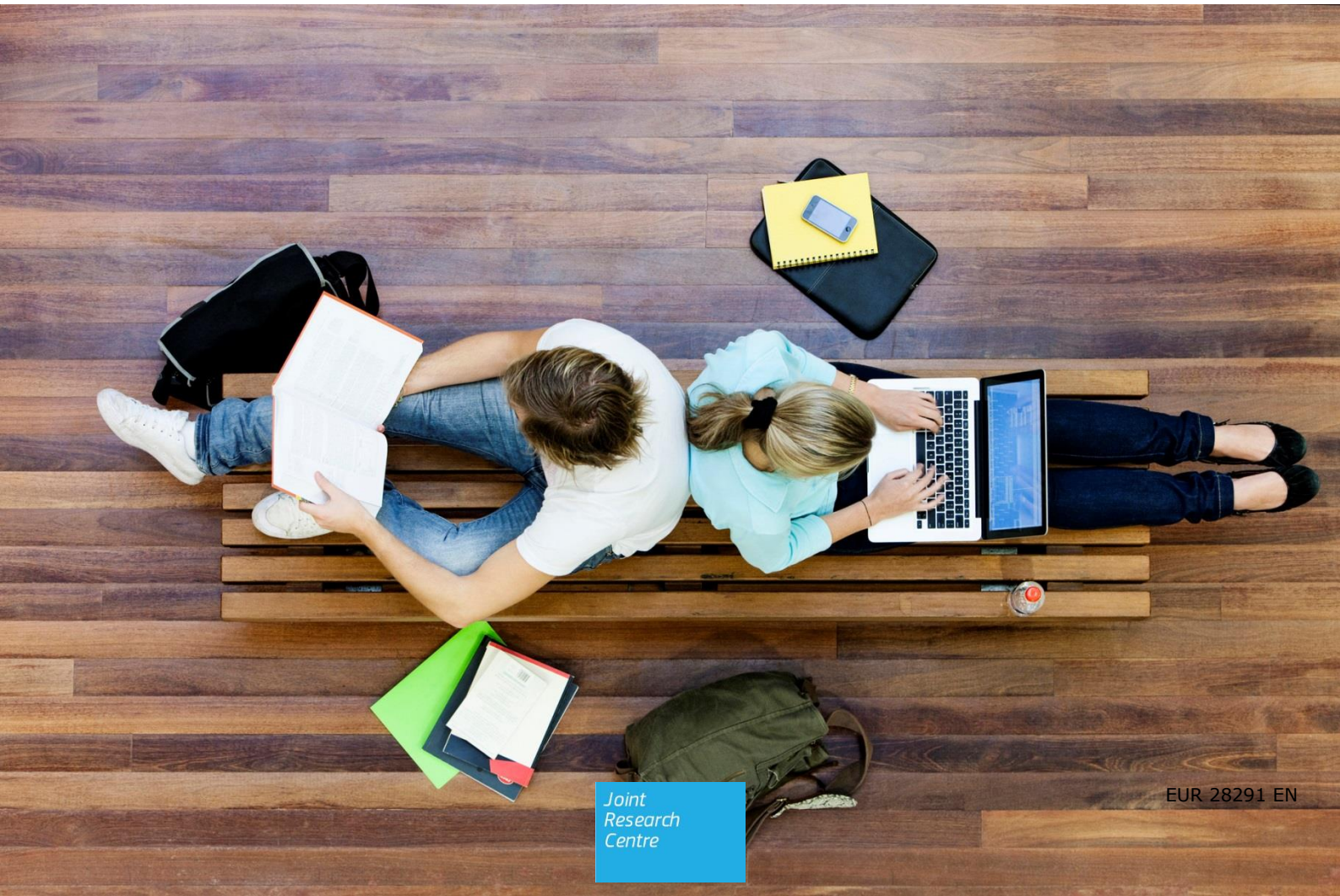
2016



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Title: Digital Reading in PISA 2012 and ICT Uses: How do VET and General Education Students Perform?

Abstract
In several Member States (MS) students in vocational-oriented programmes (VET), when compared to general education students, perform better in digital reading than in print reading in PISA 2012. Results suggest that schools should help VET students develop further their digital skills to support their learning.

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Note

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EXECUTIVE SUMMARY

The analyses presented in this report indicate that in several Member States (MS) 15 year-old students in vocational-oriented programmes (VET) perform better in digital reading than in print reading in PISA 2012. When differentiated by programme of study – VET versus general education programmes – VET students perform better in digital than in print reading in Belgium, France, Italy, Portugal and the Slovak Republic. Moreover, VET students display specific patterns of ICT-related practices. For example, they have more access to computers at school than at home and their engagement in frequent browsing of the internet for school work is associated with higher digital reading achievement. Results suggest that schools should help VET students develop further digital skills to support their learning.

INTRODUCTION

The current European framework for cooperation in education and training (ET2020) emphasizes the importance of developing transversal skills and key competences, in particular digital competences. Specific actions include raising the skill levels of pupils and the workforce by improving the effectiveness of education and training systems (European Commission, 2015). In line with this goal, the development of digital competences is a relevant priority area within the development of high-quality skills.

Digital competences encompass the use of Information and Communication Technologies (ICT) tools in teaching and learning and the development of digital literacy. ICT use is considered a driver of pedagogical innovation (European Commission, 2012a), but the reported use of ICT tools per se is perceived to be less important than the way such tools are integrated in teaching and learning (European Commission, 2012a).

Indeed, the use of educational technology is a promising avenue of pedagogical innovation and must be understood and supported. Until recently, only a few studies pointed to the modest difference it makes in students' achievement on its own (Cheung & Slavin, 2011). In large scale studies such as the Program for International Student Assessment (PISA) it was even shown to be correlated negatively with student achievement (OECD, 2015). However, new research findings address how ICT use can enhance students' learning (Wosseman, 2014) and how it can be integrated with other instructional strategies. For example, the Organization for Economic Co-operation (OECD) report Students, Computers and Learning (OECD, 2015), based on data from PISA 2012, provides evidence showing that students who browse the internet for school work score above those that never engage in this activity on the PISA digital reading scale.

The same OECD report (OECD, 2015) also shows that traditional paper-based reading explains a large proportion of students' performance in the digital reading assessment in PISA. However, a substantial portion of the variation is attributed to differences between schools, but this topic is not pursued further in the report.

In general, students in academic programmes differ from students in VET programmes. Among other differences, vocational education and training (VET) research points to weaker reading performance among VET students compared to students in general academic programmes. Even if many 15 year olds (PISA population) in European educational systems have not chosen or have been tracked into either academic or

vocational programs, analyses by OECD still suggest this to be a valid separation criteria for PISA data[1]

This report adds to the limited evidence available in what concerns the association between ICT skills and student learning. More specifically, it addresses the variation in ICT use between students in general education programmes and students attending vocational education. Moreover, it considers how ICT use by these two different groups of students is related to their achievement. In particular, this technical report seeks to identify if VET or VET oriented students in Europe display differences in reading performances with respect to both the paper and digital reading tests in PISA 2012, when compared to students in general academic programmes. Furthermore, the report explores if students who frequently browse the Internet at school show higher performance in digital tests than in paper-based tests, broken down by the students´ orientation of study. The multilevel analysis performed, includes selected EU Member States and Australia as a benchmarking country. This allows for the assessment of the possible relationships between study orientation, the time students spend browsing online and digital reading performance. This analysis will contribute to our understanding of the differences and similarities among countries and will provide evidence regarding "system efficiency" in terms of fostering students' digital reading performance.

The focus on digital reading performance presented in this report pertains to EAC's priority area "Open and Innovative Education and training, including by fully embracing the digital era". More specifically, it contributes to address key policy actions related to "… the development of digital skills and competences at all levels of learning in response to the digital revolution" (European Commission, 2015). Using PISA 2012 data, the project focuses on the availability and use of new technologies at the secondary level of learning in different educational systems.

This report is structured as follows. First, we summarize the digital priority areas envisioned by the European Commission. Second, we review evidence related to students' use of ICT and describe the learning environments in terms of availability of computers, ICT resources and pedagogical uses. Third, we discuss how we need to take into account different levels of analysis to study the relationship between ICT and learning outcomes. Fourth, we present descriptive statistics about students' reading performance and ICT uses in general and VET programmes. Fifth, we present a multilevel model to measure the portion of variance in students' digital reading performance between schools and to identify the relationship between students' ICT use

[1] See for instance http://www.oecd.org/edu/skillsbeyond-school/41538731.pdf.

and attitudes and their digital reading scores by programme of study. Finally, we conclude by summarizing the findings and by discussing policy implications.

PART I

The Relevance of Digital Performance for the European Union: The Role of Education

This section discusses the digital priority areas envisioned by the European Commission and describes the relevance of reading digital performance in education and ways to measure their relation with student achievement.

Due to the rapid digitalisation of society, reading skills in online environments are of increasing importance. Having skills in digital online reading encompasses multi-dimensional properties, and could be perceived as a partial proxy to a broader notion of digital skills or competences. Many economic sectors are undergoing rapid technological change and digital skills are needed for all jobs and yet, at present, almost half the EU population lacks basic digital skills (European Commission, 2016).

To address this, the Commission communication "A New Skills Agenda for Europe - Working together to strengthen human capital, employability and competitiveness", adopted on June 10, 2016, calls for specific actions to increase the digital skills of European citizens. More specifically, it aims to support co-operation among education, employment and industry stakeholders by focusing on the quality and relevance of digital skills in the labour force. To ensure that individuals are equipped with adequate digital skills, in this communication the Commission stresses that digital skills and competences need to be developed at all levels of education and training. Furthermore, it acknowledges that teachers and educators need support to implement best practices in bringing digital tools into the classroom. The strengthening of digital skills should be done in a transversal way across the curricula from the early stages of education and teachers should receive training in pedagogical approaches to include ICT in their teaching (European Commission, 2012).

Already in 2012, the Communication on *Rethinking Education* highlighted that education needs to respond adequately to workplace needs and called for pedagogical innovation or new ways of teaching and learning. As the European Commission has noted "technology offers unprecedented opportunities to improve quality, access and equity in education and training. It is a key lever for more effective learning and to reducing barriers to education, in particular social barriers (European Commission, 2012; Costa & Araújo, 2015). However, the last TALIS survey (OECD, 2014) reveals that teachers do not use active teaching practices, and specifically they do not use ICT for projects or class work very often. On average, across 18 European educational systems, only 7.2% of teachers report using ICT in all or nearly all lessons. Twenty seven percent report using it frequently, 47% report using ICT occasionally, while 18% report to never or nearly never use ICT for projects or class work.

As the OECD (2016) notes in their recent report on the power of digital technologies and skills, "the European Commission has been at the forefront of policy initiatives to address ICT related skills. In 2007, the Communication E-Skills for the 21st Century set the basis for its policy response to the growing demand for highly skilled ICT practitioners and to achieve digital literacy for all citizens" (p. 59). The same report shows that when it

comes to teachers, their ICT practices are determined by age. That is, younger teachers use ICT in their lessons more than older teachers do, which suggests that older teachers might benefit from professional development to integrate ICT in teaching and that those entering the profession should receive proper training to become technological savvy (OECD, 2016).

This report focuses on digital reading in PISA and, as such, it addresses only the skills aspect. Nonetheless, the digital competence framework developed for the European Commission encompasses a wide range of domains, namely skills, knowledge and attitudes (Ferrari, 2013). In what relates to skills, both retrieval and creation of content are included in this domain. However, PISA assesses only retrieval of information and not the production of online communication by using emails, for example. Therefore, we are focusing on a specific reading ability in online environments and its relation with ICT-related practices in school and at home for school purposes.

Considering the school environment, school effectiveness research has established a tradition of studying education phenomena according to "input-output" models (Sharpes, 2000), where input variables explain school output or outcomes. Current studies based on this tradition measure a school's added value in terms of what a school can add over and above student/home background characteristics (Martin, Foy, Mullins, & O' Dwyer, 2013). Most studies use available data from large-scale assessments of educational achievement and employ multi-level statistical models to investigate such added value (Kyriakides & Charalambous, 2014). School-level variables usually included in these models are contextual variable linked to resources and instructional practices, such as availability of a school library and textbooks, frequency of homework and instructional time (Sharpes, 2000).

In what refers to ICT, the OECD's PISA considers it a school input variable and collects information about ICT resources at school and about teachers' and students' use of ICT. In particular, students that participate in PISA surveys are asked whether they use ICT to accomplish specific tasks, and in the case of the latest PISA 2012 Mathematics tasks. In addition to school use of ICT, students are asked about their use of ICT at home. As explained in the PISA 2012 technical report, ICT experience, attitudes and skills are considered a school input factor linked to the learning conditions for mathematical literacy (OECD, 2014c). These learning conditions can include teachers´ ICT practices (Brummelhuis & Kuiper, 2008; Law & Chow, 2008; Pelgrum, 2008), and a schools' technological equipment, including software, internet connectivity and technical and pedagogical support (Eurydice, 2010). However, in PISA ICT practices are reported by

students. Therefore, we have an indirect measure of what students perceive that their teachers do when it comes to integrating ICT in their teaching.

Thus, ICT skills function as input much like family background and parental support and are thought to affect educational outcomes in terms of learning motivation and mathematical performance. It is well established that students' reading achievement is influenced by student-level variables related to individual student characteristics and their home family background (Araújo & Costa, 2012). For example, a study using data from the Program for International Reading Literacy Study (PIRLS) shows that students' cultural capital accounts for a large portion of the reading score differences between independent and public schools (Myrberg & Rosén, 2006). In addition, there is evidence that families with more cultural capital tend to pass on to their children the type of knowledge valued in school and which is useful for school success (Caro, Sandoval-Hernández, & Lüdtke, 2014). Another variable related with students' reading achievement is gender. In general, girls perform better than boys in reading and this finding has been repeatedly encountered both for primary and secondary educational levels (Mullis et al., 2007; OECD, 2010a). Also, in Europe there is a performance advantage for students without an immigrant background (OECD, 2010b). These are important student background variables to take into account in any analysis of the relation between achievement and ICT uses.

Finally, considering the way the digital reading achievement of students is measured in PISA the assessment mimics a real online experience. Computer-based assessment (CBA) in PISA 2012 allowed for the use of multiple texts simultaneously, just like students are likely to encounter in a typical internet situation (OECD, 2015). To find answers for reading questions, students could navigate through text, using hyperlinks to retrieve the information. The quality of this behaviour, or the ability of students to use the appropriate links in a swift fashion is related to their achievement. That is, the savvier they are in navigating to accomplish specific reading tasks the better is their reading achievement (OECD, 2015).

PART II

Students' ICT Performance and Learning Environments: Review of Empirical Evidence

This section reviews the theoretical background and the research evidence related to students' use of ICT at home and at school. It describes the learning environments in terms of availability of computers, ICT resources and pedagogical uses. The studies reviewed include those that use data from large-scale assessments, such as PISA and TIMSS, and that explore the relationship between ICT and students' achievement.

The following theories offer an explanation for why there might be a relationship between computer use and reading achievement (Rosén & Gustafsson, 2014, p. 208-209):

- "*Displacement theories* argue that time is a limited commodity. If computer time replaces reading and educational activities, this may have negative effects on the development of reading skills."
- "*Activation theories*, often relied on in research on stress, are based on the idea that the brain needs to be activated to a certain level in order to function well. There may be a damaging effect on cognitive functioning if the computer tasks undertaken either under- or over-activate the brain through passive reception or information overload. On the other hand, if the tasks are instead interactive and cognitively challenging to just the right degree then computer use can result in positive effects on intellectual development."
- *Content theories* argue that the effect is a function of the content of computer (and other media) use. The effect can be positive or negative depending upon the content (e.g., an educational programme versus computer games)."

Evidence indicates that reading skills are indeed a precious commodity. Most of the variation in digital reading achievement in PISA 2012 is explained by students' print reading (OECD, 2015). That is, students who perform well in print reading tend to also perform well in digital reading. Thus, ensuring that students are good readers does more to promote high achievement and increase equity, or equal educational opportunities for all, than increasing ICT resources at school (OECD, 2016). Good reading skills, above PISA's baseline level of proficiency, are characterized by the ability to critically evaluate the content of a text, to mobilize content knowledge and to make inferences about the information presented (OECD, 2013). Schooling has a main effect on the developing of these literacy skills, but reading outside of school activities also helps develop these abilities to process written information. For example, research shows that socially disadvantaged youngsters who read frequently for recreational purposes equal or surpass their more advantaged peers who read less in reading performance (Chall & Jacobs, 2003; OECD, 2007).

Experts on reading development view reading for enjoyment as a result of good foundational reading skills. That is, better readers read more and because they read more they become better readers (Stanovitch, 2000). This reciprocal causality is known in reading research as the *Mathew effect*. Thus, for students to develop as skilful and strategic readers we have to ensure effective reading instruction from the early years in

order to give students the foundational skills to develop as good readers (Eurydice, 2011). Then the more they read on their own outside of school will make them even better readers (Araujo & Costa, 2012).

Rosén and Gustafson's (2014) studies with Swedish students show that decreased time spent reading for fun outside of school resulted in worse reading achievement in fourth grade. Thus, there is some evidence that displacing or substituting reading for other activities, namely spending time on the computer, can negatively impact reading achievement and this is what displacement theories predict. In their studies with data form different waves of the Program for International Reading Literacy Study (PIRLS), these authors found that the availability of computers at home contributed to a decrease in reading performance among 10-11 year olds. They analyzed the difference in the reading performance of students in this age range using PIRLS 2001 and PIRLS 2006 and assessed reading trends and achievement between 1991 and 2006. In both comparisons, trends suggest that students in 2006 have lower reading scores and that this is associated with more availability of computers at home (Rosén & Gustafson, 2014).

Similarly, Fuchs and Mossmann's (2004) study, with PISA 2000, had showed that computer availability at home had a negative effect on reading achievement. In contrast, a subsequent report by OECD (2006), based on PISA 2003, concluded that availability of computers (at school or home) had a positive relation with performance. Those students who used computers more often had better results in PISA 2003.

These studies, however, say little about the impact of computer habits and achievement (Rosén & Gustafsson, 2014). This is because the variables linked to the use of ICT in surveys like PIRLS or PISA were initially more related to availability than to actual use and don't always focus on the type of activity done on the computer. This may partly explain the conflicting negative and positive associations found, but when actual use is measured studies tend to find positive results. For example, Subrahmanyam et al. (2001) conducted a review of research on ICT use and found that several studies suggested a positive relation with academic achievement. Fiorini (2009), for instance, found evidence of positive test score effects of computer use at home in a large sample of young Australian children. Specifically, he found that more time spent on the computer at age 4/5 was positively related with higher scores on standardized vocabulary and reasoning tests at age 6/7. Since vocabulary knowledge acquired through parental book reading during childhood is known to assist children in developing reading skills in fourth grade (Araujo & Costa, 2015; Sénéchal, 2012) this is a significant finding. It may indicate that computer use during the preschool years may also

contribute to enhance students' future reading comprehension. Nonetheless, we can only speculate that the type of computer use stimulated the intellectual development of young children in much the same way as home shared book reading does. If this is the case, according to the activation theories, when computer tasks are interactive and cognitively challenging learning takes place.

In what refers to the third theory postulating that any effect of computer use on achievement is a function of the content students are exposed to, recent evidence suggests that this theory has explanatory power. As Wosseman et al. (2015) found with TIMSS data, using computers to look up ideas improves students' achievement, but using them to practice skills reduces achievement. This is also a significant finding, as it specifically addresses different pedagogical uses of the computer and their effect on mathematics achievement at the eighth grade level. Similar pedagogical uses or practices have also been reported by teachers who participated in TALIS (OECD, 2013). For example, Mathematics and Science teachers in Denmark and Norway reported that they make their students use ICT for projects or class work frequently or in all or nearly all lessons.

Clearly, availability, use, and perhaps more importantly, the type of ICT use at school and at home are aspects that can condition results and related conclusions about the effects of computers on achievement. We know from data analyses of the last PISA 2012 that 91% of European students attend schools with computers available for instruction that are connected to the internet, but that ICT is widely used only by schools in Denmark (85.3%), Norway (81.3%), Sweden (67.5%), the Netherlands (54.5%) and Finland (50.1%) (Costa & Araújo, 2015). Furthermore, although PISA data indicates that in most Member States there is a positive correlation between availability and use (Fucks & Wöbmann, 2005; Costa & Araújo, 2015), some teaching practices are negatively associated with achievement. For example, Falck, Mang and Woessmann (2015) found that practicing and drilling exercises by using ICT in mathematics, as measured in TIMSS, are related to poor achievement.

In sum, large-scale surveys such as TIMSS and PISA can shed light on the type of ICT use and its relation with students´ achievement. Nonetheless, oftentimes aspects such as intensity of use (Biagi & Loi, 2013) are not captured in such assessments. Moreover, quality of use, or digital competence, is rarely measured in a meaningful way. Hatlevik, Guomundsdóttir and Loi (2015) measured the knowledge and strategic use of digital information by eighth grade Norwegian students and found that it accounted for 30% of variation in digital competence. In their study with national data, specific tasks like how to upload a video for a presentation and how to refer to sources in an assignment were

assessed, as well as retrieving information from texts. Similarly, some activities, such as playing computer games at home have been found to relate to high achievement (Biagi & Loi, 2013), but we do not know which games students play and which are more conducive to learning. Thus, there is still much to be learned about the nature of activities that can contribute to the development of digital competences and to student learning.

The PISA report "Students, Computers and Learning" comes closer to pinpointing which ICT practices students more commonly engage in and which are more associated with achievement (OECD, 2015). Importantly, it shows that students' print reading score explains their achievement in digital reading and that more frequent internet browsing relates to higher digital reading scores. Nonetheless, while it is true that students that perform well in print reading also tend to perform well in digital reading, there is still variation when considering students that perform at the same reading proficiency level. For example, in some countries students performing at level 2 are better in digital reading whereas in other countries they are better in print reading (OECD, 2016). This suggests that the quality of browsing, of navigating between hyperlinks matters and that those that have more experience and perhaps guidance in processing online texts have an advantage when it comes to understanding digital texts. Research findings also support the idea that different text structures may have different effects on text recall and comprehension. For instance, associative hyperlink structures may be superior to linear structures for understanding news (Cauwenberge, d' Haenens & Beentjes, 2015), which again reinforces the notion that given the same underlying ability, other aspects such as the quality of the digital support and the quality of navigation may indeed affect text comprehension.

The aim of this report is to extend this knowledge base by investigating specifically how vocational-oriented students perform in digital reading, when compared with general education students and what ICT practices facilitate their understanding of text in PISA.

PART III

Students' Reading Performance and ICT Use in General and VET Programmes

This section details the data sources used and offers an overview of descriptive statistics concerning students in general and VET programmes in EU MS according to students' reading achievement in print and digital tests. Other factors, such as the frequency of ICT practices and availability of ICT resources are explored, as well as gender differences in the different academic programmes.

3.1 Data Source

The Program for International Study Assessment (PISA) is a cross sectional survey that was launched in 2000 by the Organization for Economic Co-operation and Development (OECD). Since then the OECD has been running this international large assessment of 15 year old students' skills in Mathematics, Science and Reading every three years. Each assessment cycle presents a more complete picture of only one of the knowledge areas.

The main domain in PISA 2012 was mathematics. This assessment cycle "evaluated not only how proficient 15-year-olds are in gathering and processing information that they acquire when reading printed texts, but also how proficient they are in reading digital material (PISA in Focus n. 55, 2015, p.1). Thus, PISA 2012 was designed to address students´ ability to read, navigate and understand online texts. A simulated browser environment, with websites, tabs and hyperlinks, provided a controlled setting in which students' reading performance, but also their browsing behaviour, could be observed.

This report is based on PISA 2012 computer based assessment (CBA)[2] which includes data for students' achievement in print and digital test formats, as well as all the variables from the optional Information Communication Technology (ICT) questionnaire. The focus in this report is on the reading domain and on exploring how general and vocational students´ (VET) reading achievement is related to their use of ICT. This focus was motivated by the fact that the 2015 OECD report on ICT did not explore patterns of ICT use according to students´ orientation of study and found that, irrespective of programme orientation, print reading was a predictor of digital reading. As defined by OECD[3], "Vocational education prepares participants for direct entry, without further training, into specific occupations. Successful completion of such programmes leads to a labour-market relevant vocational qualification. Some indicators divide vocational programmes into school-based programmes and combined school and work-based programmes on the basis of the amount of training that is provided in school as opposed to training in the workplace".

A description of the patterns that characterize students´ use of ICT by field of study and its relation to achievement will provide additional information. More specifically, it will help us understand which ICT uses and associated pedagogical practices in vocational and general programmes are related to achievement. For example, research by Hanushek and Wosseman (2015) using TIMSS data has already shown that using ICT to practice drilling exercises in eighth grade mathematics classrooms has a negative effect

[2] Data available at: https://www.oecd.org/pisa/pisaproducts/database-cbapisa2012.htm
[3] https://stats.oecd.org/glossary/detail.asp?ID=5451

on achievement, whereas browsing the internet for school work is positively related to achievement.

In PISA 2012 the variable "Programme orientation" (ISCEDO) indicates whether the programme's curricular content is (1) general; (2) pre-vocational; (3) vocational; or (4) modular programmes. In this report, VET oriented students are one category obtained by aggregating the categories "vocational" with "pre-vocational" of the ISCEDO variable.

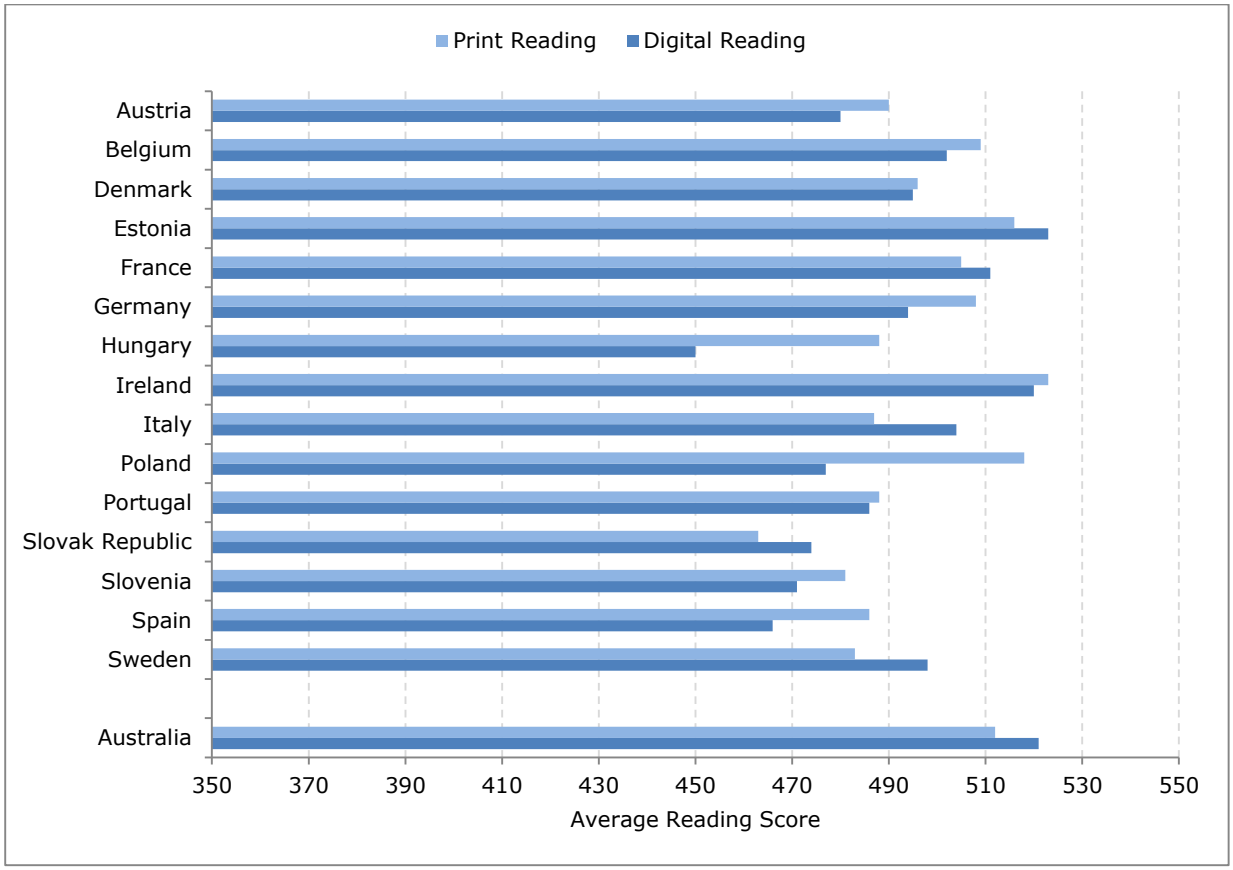
3.2 Print versus Digital Reading Performance in Europe

Fifteen European Union Member States (EU MS) participated in both the print and digital reading assessments in 2012: Austria, Belgium, Denmark, Estonia, France, Germany, Italy, Ireland, Hungary, Poland, Portugal, the Slovak Republic, Slovenia, Spain and Sweden. The figure below shows the mean score in digital and print reading in PISA 2012 of these EU MS, plus Australia (used as a benchmarking country).

The top-performing EU MS in the PISA assessment of digital reading are Estonia, Ireland, Italy and Belgium. Regarding print reading performance, the best performers are Ireland, Poland, Estonia, Belgium and France. Australia is also a top performing country, both in digital and print reading.

In general, the performance in digital and print reading shows that it is not possible for students to read online without being able to understand and draw adequate inferences from print texts too (OECD, 2015). However, students in Sweden, the Slovak Republic, Italy, France and Estonia perform better in digital than in print reading. The same is true in Australia. On the other hand, students in Poland and Hungary – both strong performers in print reading – have greater difficulty in transferring their print-reading skills to an online environment.

Figure 1. Performance in digital and print reading in 2012



Source: CRELL analysis based on PISA 2012 CBA data. *See also Table 1, Annex A.*

3.3 An Overview of students in general and VET programs in Europe

In order to provide an overview of the profiles of students in VET oriented programmes and general programmes, the analyses are presented for the EU MS where there is reliable[4] data for this comparison, namely: Austria (AT), Belgium (BE), France (FR)[5], Hungary (HU), Italy (IT), Portugal (PT), the Slovak Republic (SK) and Slovenia (SI). As previously mentioned, Australia will be included in the analysis as a benchmarking country.

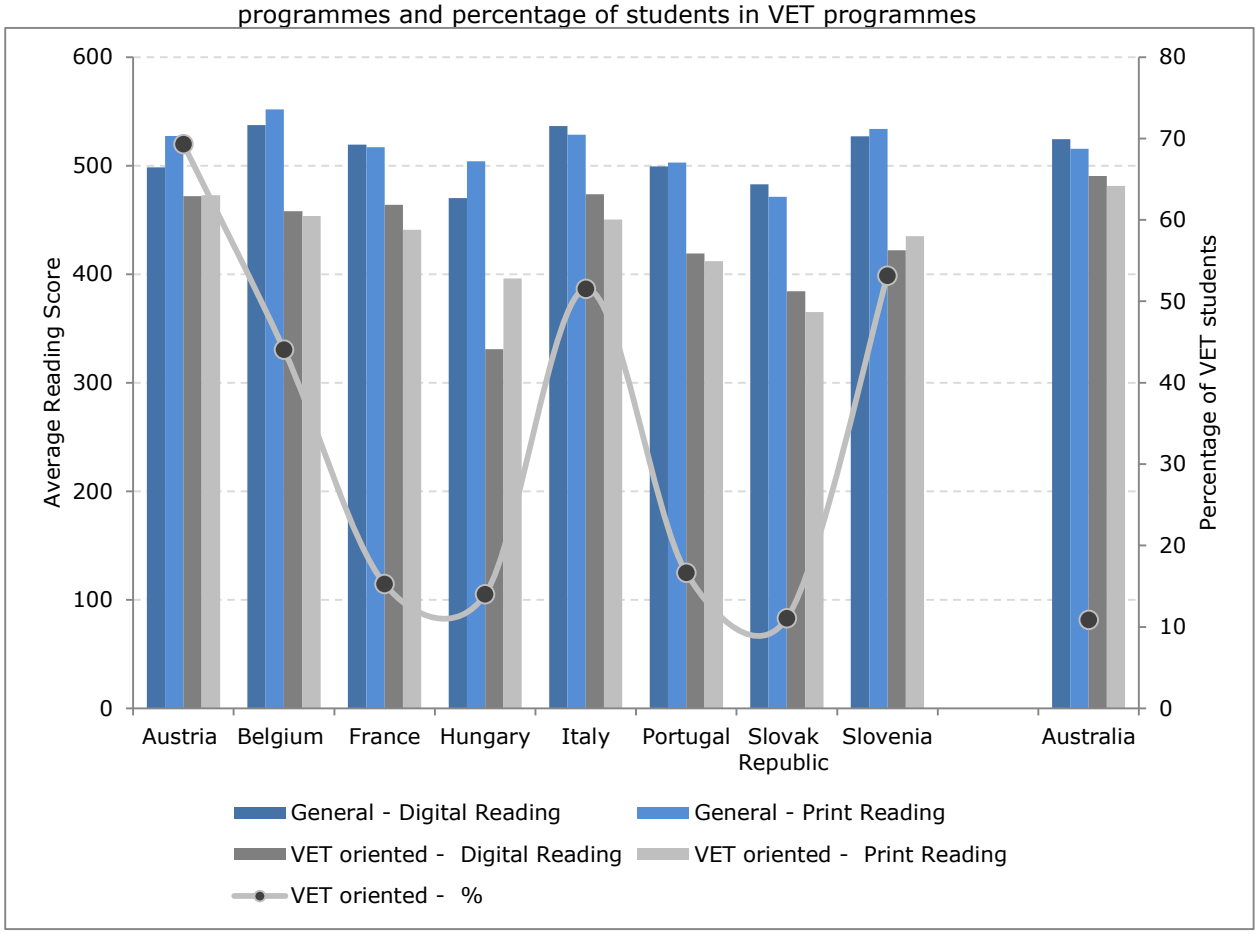
[4] Following the criterion set by OECD for statistical analyses with VET students, only countries with a minimum of 3% of students enrolled in VET programmes were considered for the analysis.

[5] In France data for the Information Communication Technology (ICT) questionnaire is not available.

3.3.1. Reading Performance

Figure 2 presents the percentage of students in VET programmes by country as well as the performance in digital and print reading of students in general and VET oriented programmes.

Figure 2. Performance in digital and print reading of students in general and VET oriented programmes and percentage of students in VET programmes



Source: CRELL analysis based on PISA 2012 CBA data. *See also Table 2, Annex A.*

The percentage of students in VET oriented programmes varies widely across countries. In the Slovak Republic and Australia 11% of the students participating in PISA attend VET oriented programmes while in Austria 69% of students are enrolled in vocational programmes.

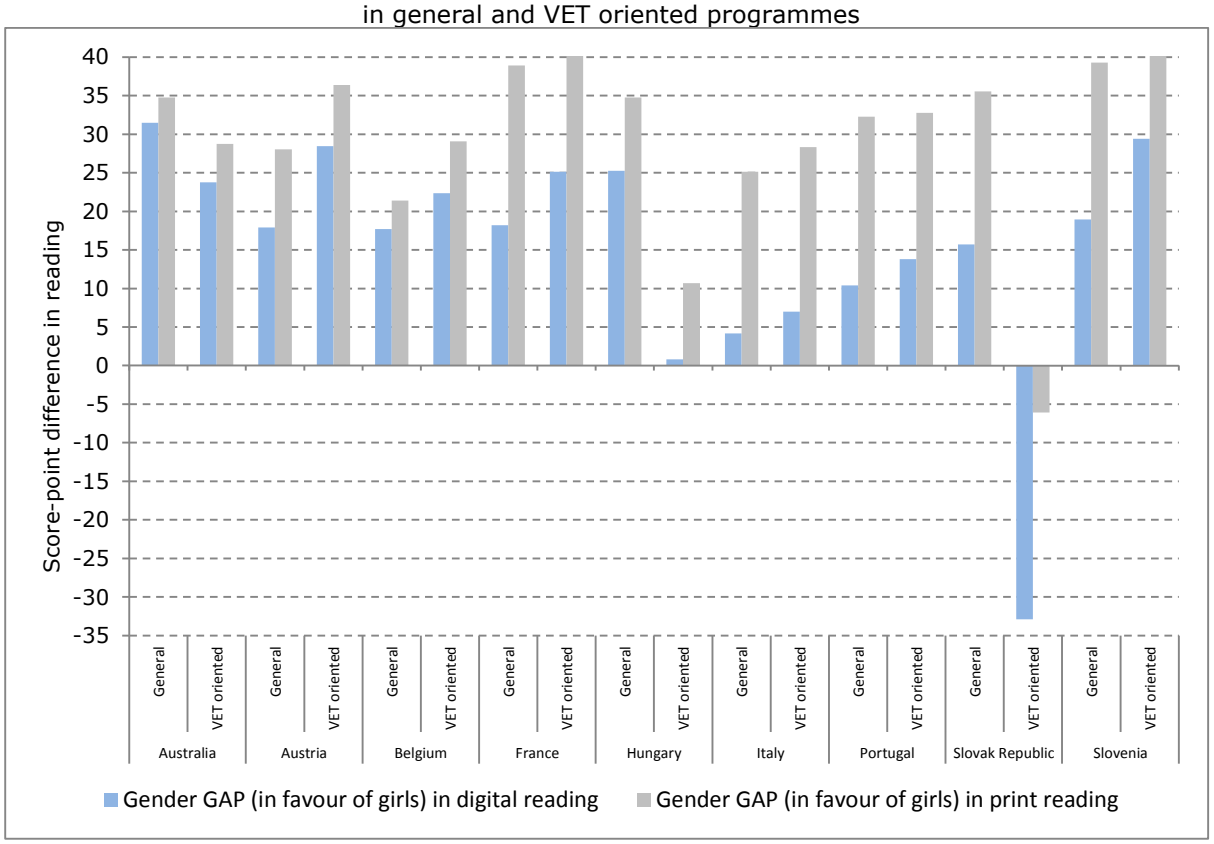
In all countries the students enrolled in general programmes outperform, on average, the students in VET oriented programmes both in digital and print reading. The largest differences are found in Hungary, the Slovak Republic, Slovenia, Portugal and Belgium. For students in general programmes of study, in 4 out of 9 countries (8 EU MS and Australia) the performance in digital reading is slightly higher than in print reading. Meanwhile, in 5 out of 8 EU MS the students enrolled in VET oriented programmes have greater ease in transferring their print-reading performance to an online environment.

That is, in these countries students are better in digital reading than in print reading. The graph also shows that in France, Italy and the Slovak Republic students both in general and VET programmes perform better in digital reading than in print reading. The same is true in Australia.

A comparison of the results presented in figure 2 with those in figure 1 tells us that when differentiated by programme of study – general vs VET - students continue to perform better in digital reading than in print reading in France, Italy, the Slovak Republic and Australia. In contrast, the pattern changes in Austria, Belgium and Portugal. In these countries students in VET oriented programmes have higher digital reading performance while in figure 1 when undifferentiated by program of study, students were better in print reading. This shows that when we distinguish between VET and general students different patterns are found.

Figure 3 reveals the difference between the reading performance of girls and boys by program of study.

Figure 3. Score-point difference in reading by gender
in general and VET oriented programmes



Source: CRELL analysis based on PISA 2012 CBA data. *More information in Table 3, Annex A.*

Girls outperform boys in digital reading both in general and VET oriented programmes, with the exception of the Slovak Republic. The gender differences are wider in print reading than in digital reading. In 6 EU MS (Austria, Belgium, France, Hungary, Portugal

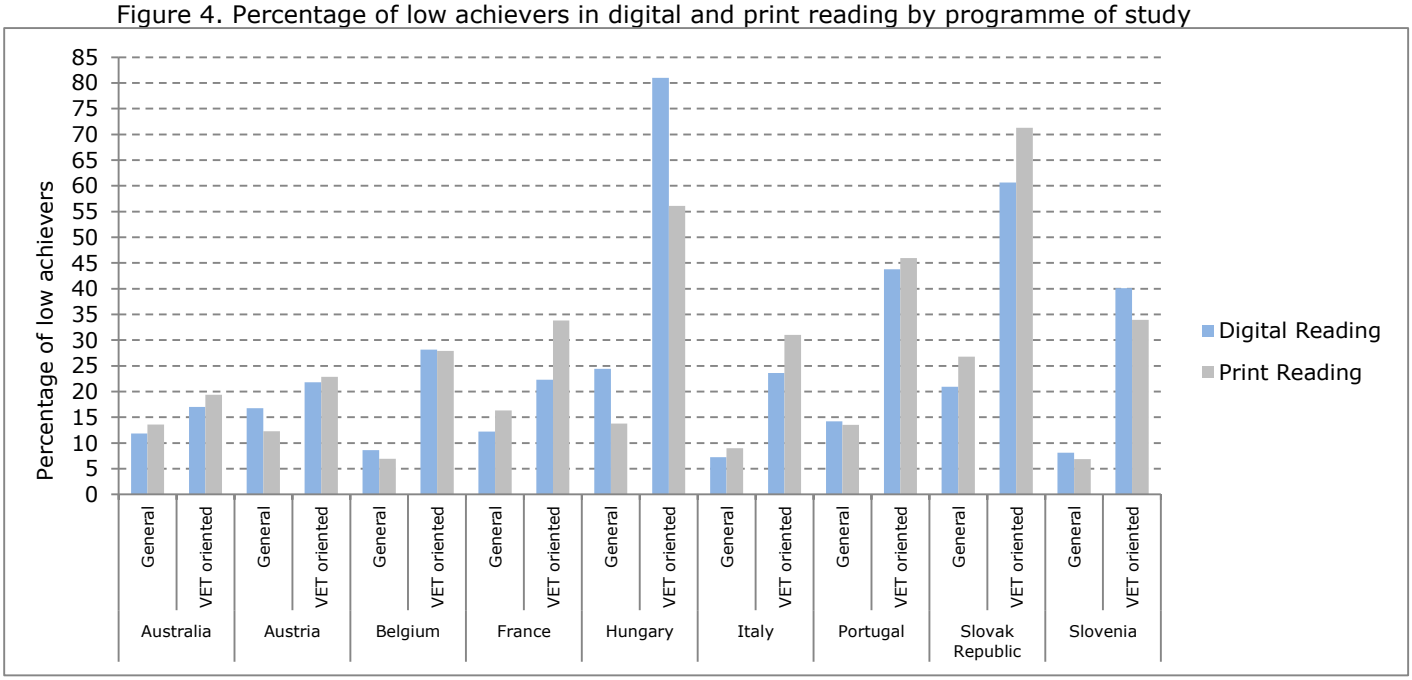
and Slovenia) girls' performance is higher in print reading than in digital reading (Table 3 in Annex A). For VET oriented students the gender gap tends to be wider than for general education students, both in digital and print reading.

3.3.2. Low achievers

The difference in digital reading and print reading performance between students in general and VET oriented programmes is also relevant in terms of poor performers (or low achievers). When considering the EU2020 benchmark of reducing the share of low achievers in Member States, VET students represent, as expected, a bigger share of low achievers in print reading. Poor performers in digital reading are those able to locate and interpret information that is well-defined and usually related to familiar contexts. In particular, when explicit directions are given these students can navigate across a limited number of sites. The poor performers in print reading are those who have not achieved a baseline proficiency in reading (score below 408 points). They are able to recognize the main idea in a text about a familiar topic and to recognize the connection between such information and their daily lives.

The poor performance of VET students in countries like Austria that have early tracking systems has been well documented (OECD, 2010c).

Figure 4. Percentage of low achievers in digital and print reading by programme of study



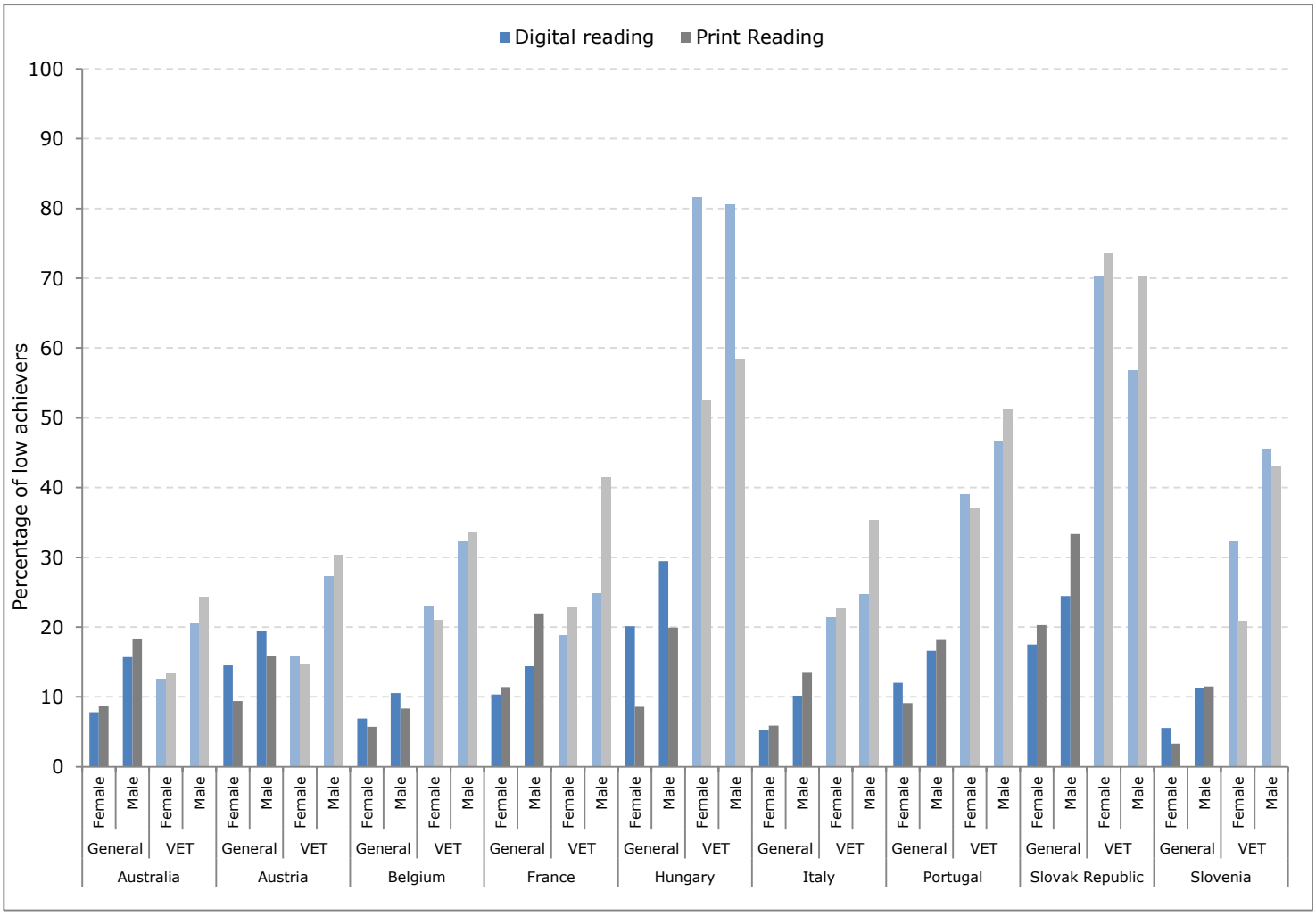
Source: CRELL analysis based on PISA 2012 CBA data. *See also Table 4, Annex A.*

In all countries the percentage of low achievers is higher for VET oriented students than for students in general programmes of study (figure 4). This is true both for digital and

print reading. While the percentage of low achievers in general programmes of study vary from 7% (in Italy) to 27% (in the Slovak Republic), the percentage of low achievers in VET oriented programmes varies between 17% (in Australia) to 81% (in Hungary), when considering both digital and print reading.

Findings from section 3.3.1 of this report revealed some interesting differences between the skills of girls and boys in the digital and print domains. Figure 5 shows the percentage of low achievers by gender. The results clearly show that the percentage of low achievers is higher for boys than for girls both in digital and in print reading. In contrast, in the Slovak Republic for VET students there is a higher percentage of girls performing poorly in digital and in print reading. The same is true in Hungary for VET oriented students in digital reading. Additionally, the gender gap of poor performers is narrower for students enrolled in general programmes of study.

Figure 5. Percentage of low achievers in general and VET programmes of study by gender for digital and print reading



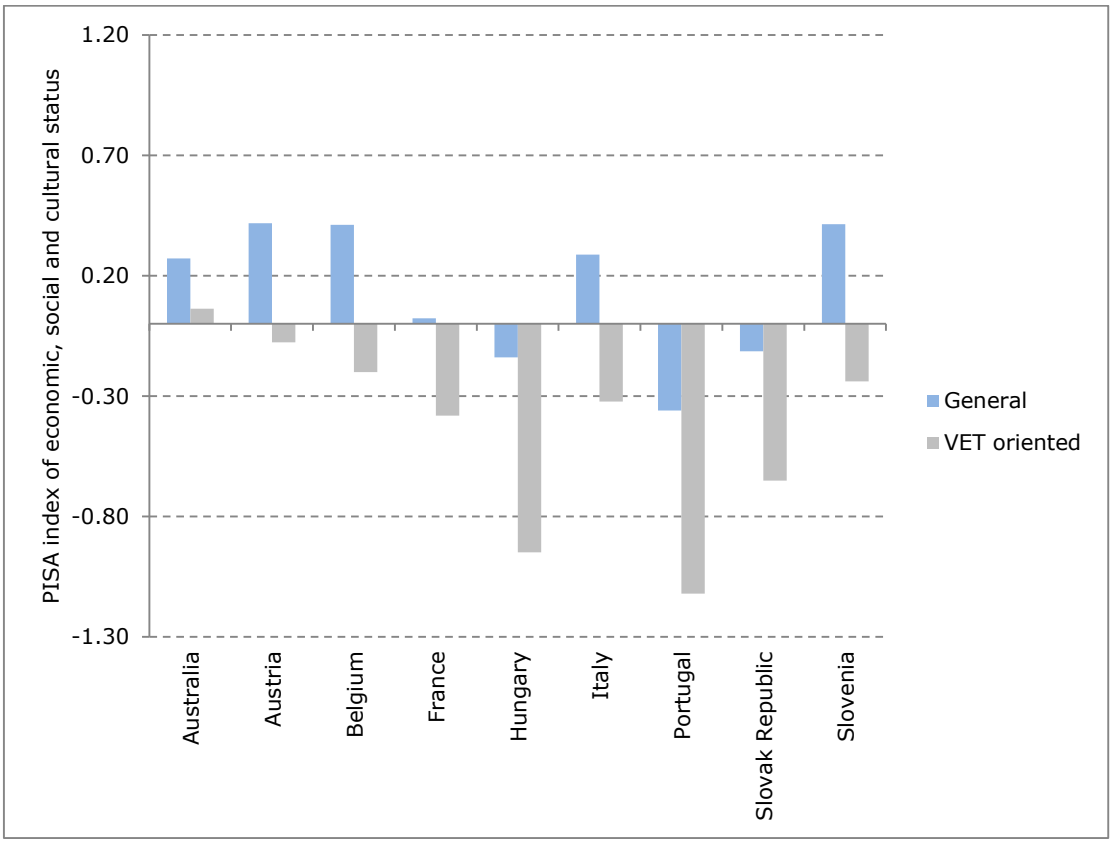
Source: CRELL analysis based on PISA 2012 CBA data. *See also Table 5, Annex A.*

3.3.3. Socio-economic characteristics

In order to provide information about the students´ background in general and VET oriented programmes of study, figure 6 shows the PISA index of economic, social and cultural status (ESCS)[6].

Students enrolled in VET oriented programmes of study present lower values of ESCS, showing that there are more disadvantaged students in VET oriented programmes than in general programmes. The countries with the highest disparities between advantaged and disadvantaged students are Hungary, Portugal, Italy and Slovenia.

Figure 6. Socio-economic status of students in general and VET programmes of study

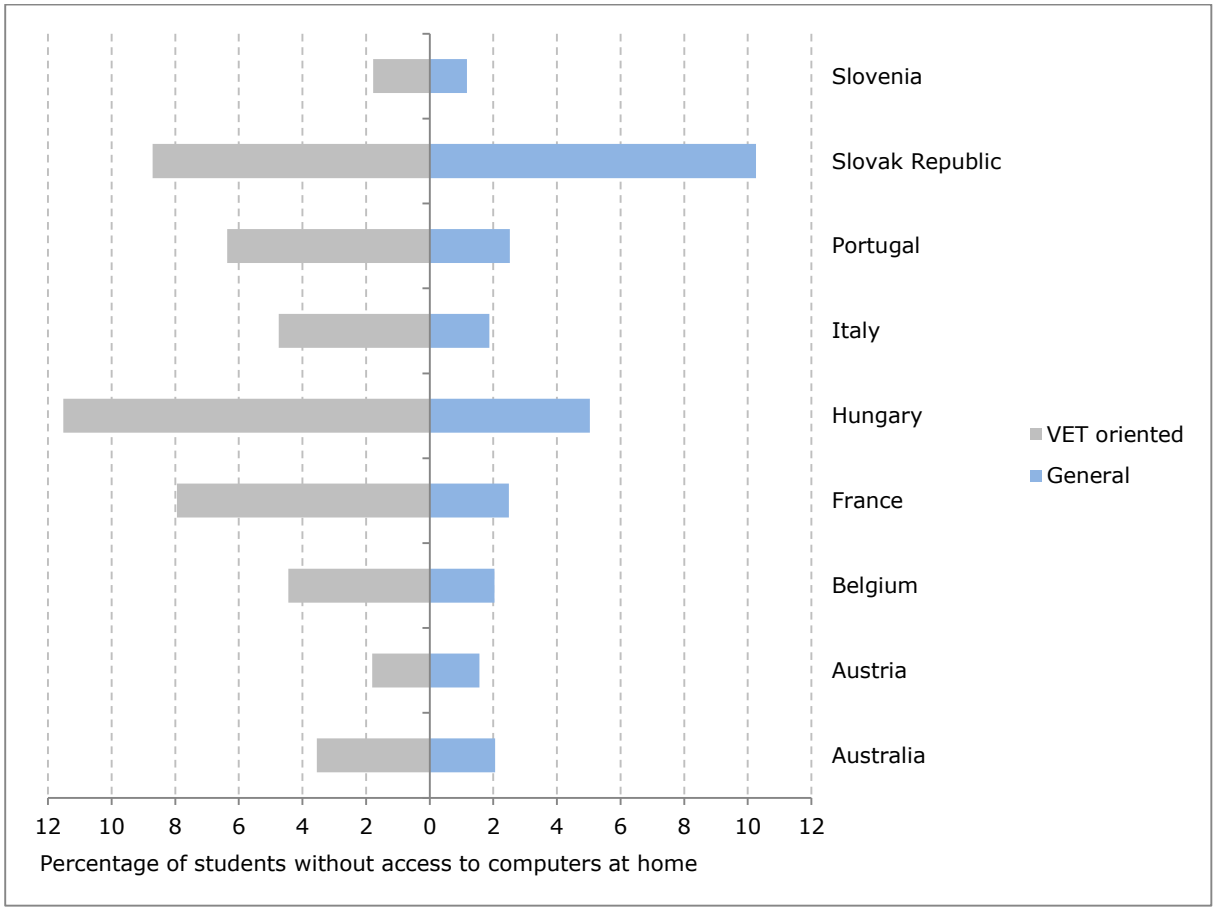


Source: CRELL analysis based on PISA 2012 CBA data. *See also Table 6, Annex A.*

Figure 7 presents the percentage of students without access to computers at home and figure 8 offers information on the percentage of students with access to the internet at school, but not at home.

[6] The ESCS in PISA 2012 is composed of three sub-components, the highest parental occupation, the highest parental education expressed as years of schooling and the index of home possessions, as well as books in the home recoded into a four-level categorical variable (fewer than or equal to 25 books, 26-100 books, 101-500 books, and more than 500 books) (OECD, 2014, p. 353). This index is based on information gathered from the student questionnaire and is scaled so that a value of 0 indicates the OECD average and a value of 1 indicates the average standard deviation across OECD countries.

Figure 7. Percentage of students in general and VET programmes of study **without** access to computers at home

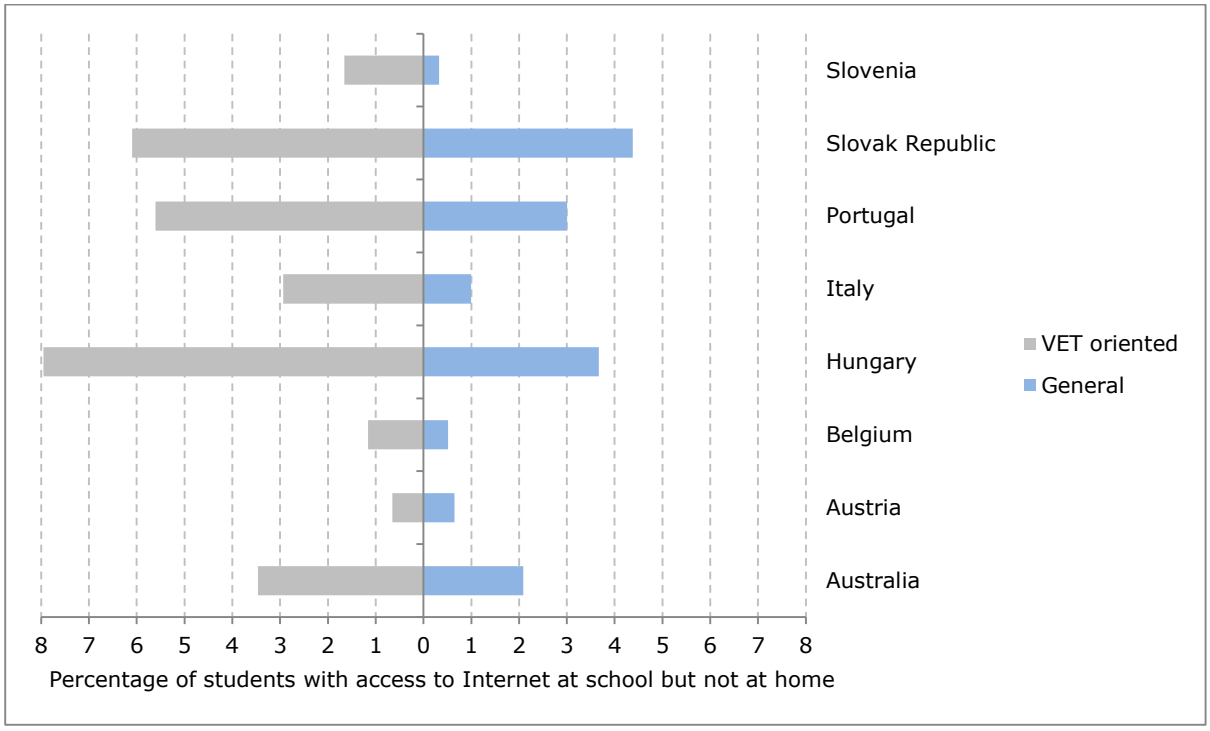


Source: CRELL analysis based on PISA 2012 CBA data. *See also Table 7, Annex A.*

The graph clearly shows that students in VET oriented programmes have less access to computers at home, which is probably related to the fact that there are more economically disadvantaged students in VET than in general programmes. The exception is in the Slovak Republic where the availability of computers at home for VET students is higher than for students in general programmes.

Interestingly, the pattern of internet access at school versus at home is the reverse. That is, VET students have more access than general education students to internet at school. This suggests that, in accord with the substitution theory, Member States are compensating for the lack of learning conditions in the home (Araújo & Costa, 2015). This is what the public resources substitution theory aims to achieve: The quality and quantity of public resources should reduce the importance of family background (Caro & Lenkeit, 2012).

Figure 8. Percentage of students in general and VET programmes of study with access to internet at school but not at home



Source: CRELL analysis based on PISA 2012 CBA data. *See also Table 8, Annex A.*

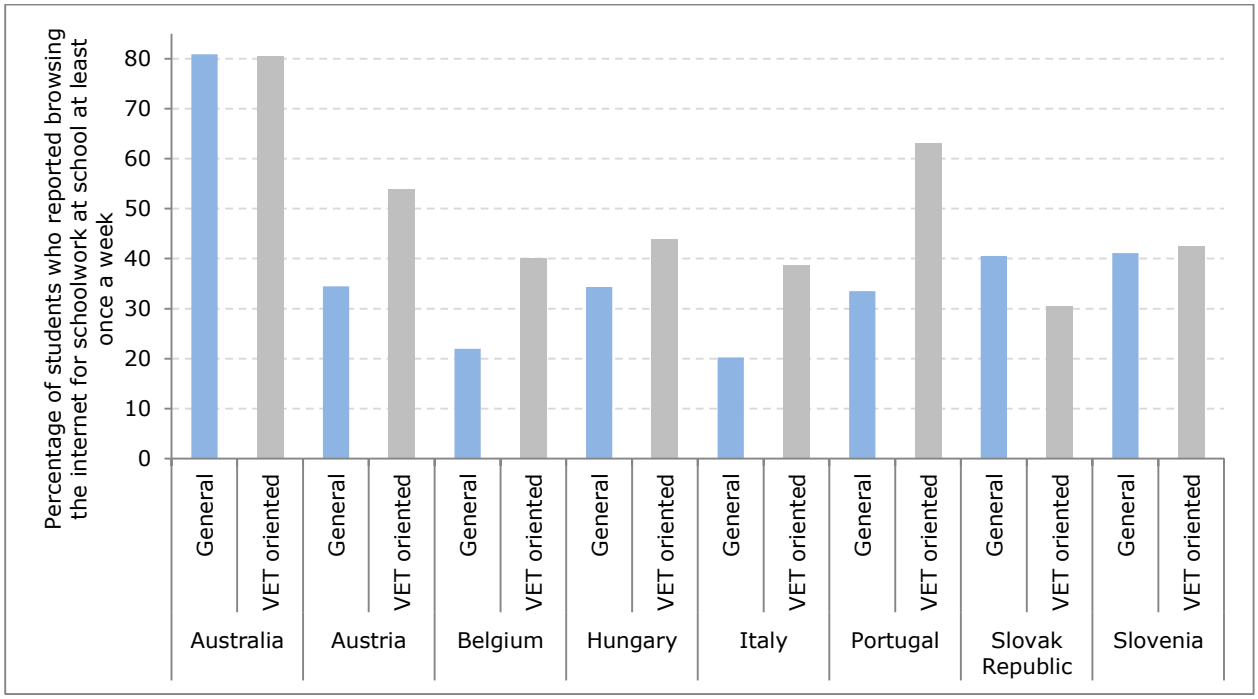
3.4 Students use of ICT in general and VET programmes

Regarding ICT related tasks performed on school computers by orientation of study, Figure 9 presents the percentage of students who reported browsing the Internet for schoolwork and Figure 10 shows the percentage of students who report engaging in practicing and drilling exercises (such as for foreign language learning or mathematics) at least once a week.

In almost all countries the share of VET oriented students that browse the internet for school work is higher than the share of students in general programmes engaging in this task. The exception is the Slovak Republic.

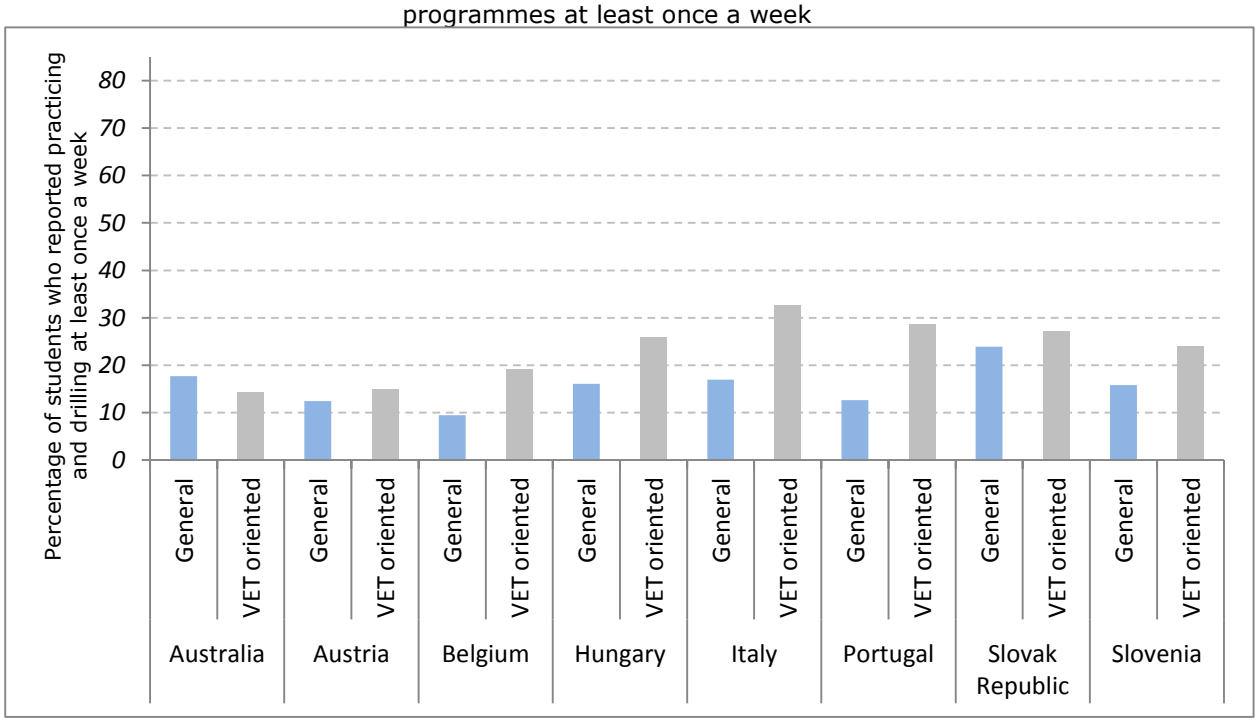
The highest shares of VET oriented students using the internet for schoolwork at least once a week are found in Austria and Portugal. Belgium and Italy are the countries where students in general programmes report a lower use of internet for school work at school.

Figure 9. Percentage of students who reported browsing the internet for schoolwork at school in general and VET oriented programmes at least once a week



Source: CRELL analysis based on PISA 2012 CBA data. *See also Table 9, Annex A.*

Figure 10. Percentage of students who reported practicing and drilling in general and VET oriented programmes at least once a week



Source: CRELL analysis based on PISA 2012 CBA data. *See also Table 10, Annex A.*

The percentage of students who use computers for individually practicing and drilling exercises is much lower than for browsing the internet for school work in both programmes of study. However, as it was found for browsing the internet, a higher

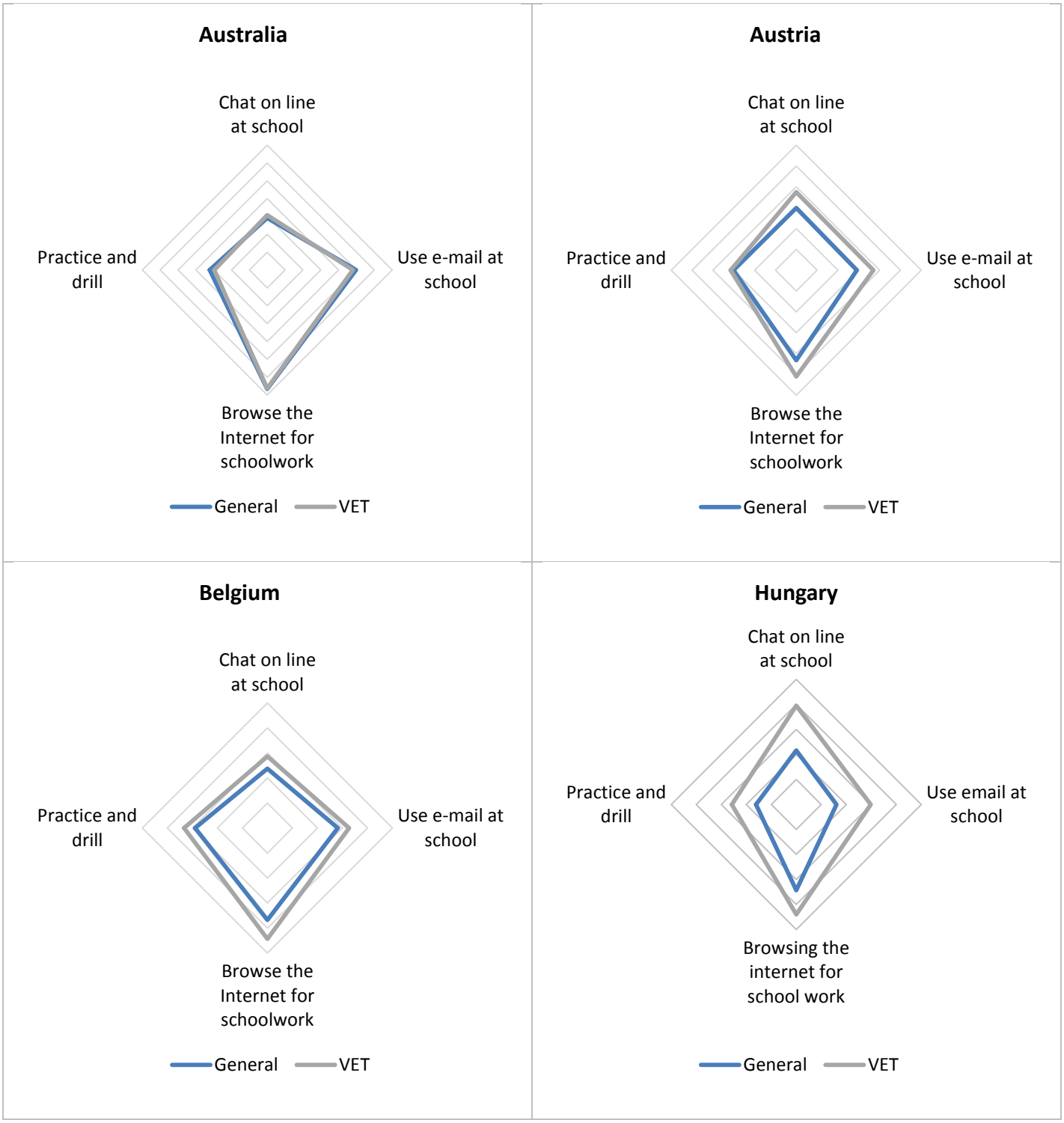
percentage of vocational students reported practicing and drilling for school work at least once a week, compared with the students enrolled in general programmes.

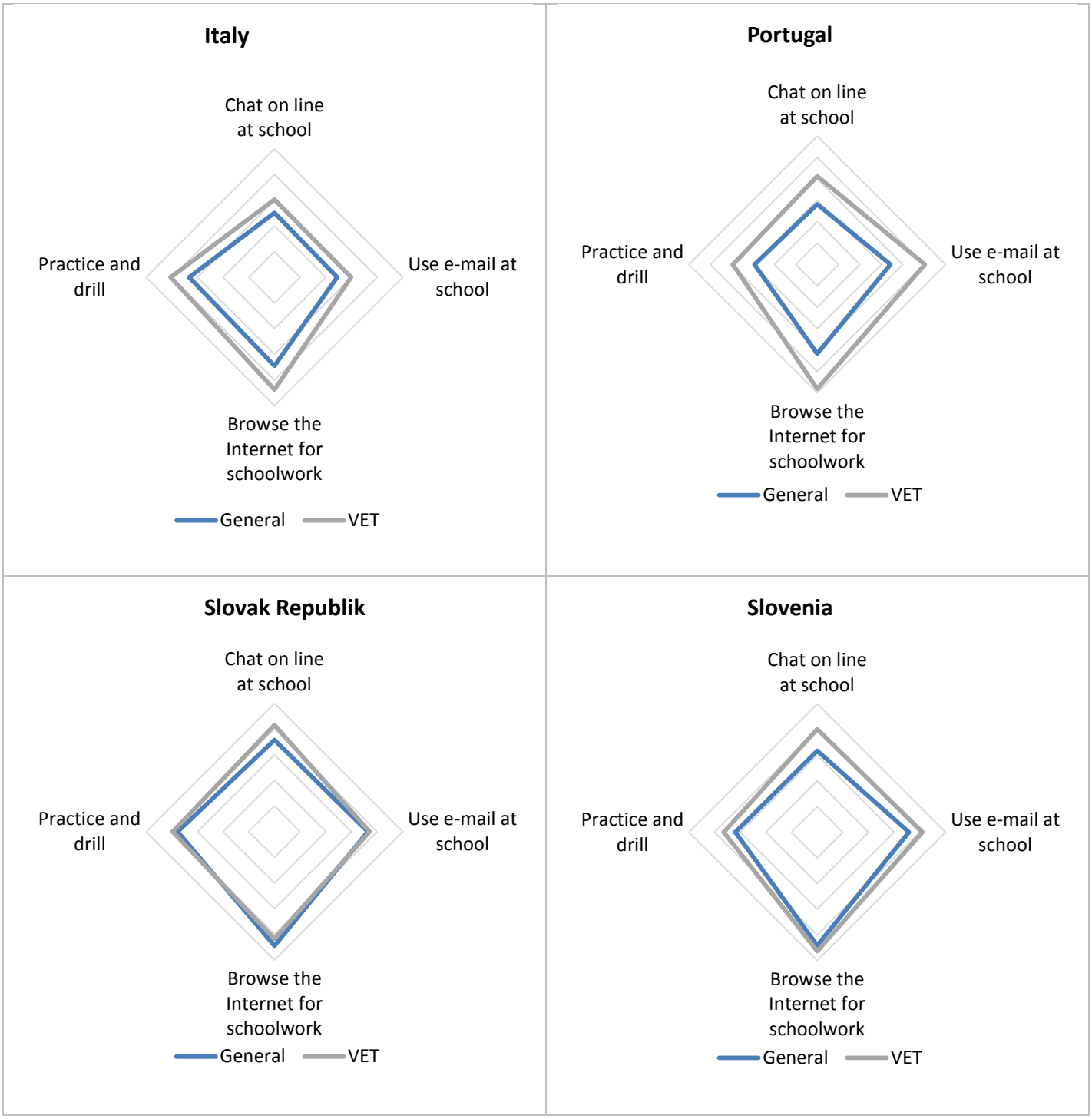
When considering computer-related behaviours, these two, displayed in the following graphs are the ones that present the widest differences between VET and general education students.

In addition to the tasks of browsing the internet for school work and practicing and drilling, OECD found that there are two more tasks frequently performed by students on school computers, namely the use of email at school and chatting on-line at school (OECD, 2015). For comparison purposes, Figure 11 below shows the frequency with which students engage in these four tasks at school and for school work, when differentiated by programme of study. Specifically, the results are presented in terms of the percentage of students reporting to engage in these tasks at least once per week.

There is a higher engagement on ICT related tasks performed on school computers from VET oriented students than general education students. That tendency is particularly pronounced in Portugal and Hungary.

Figure 11. ICT use at school of students in general and VET oriented programmes



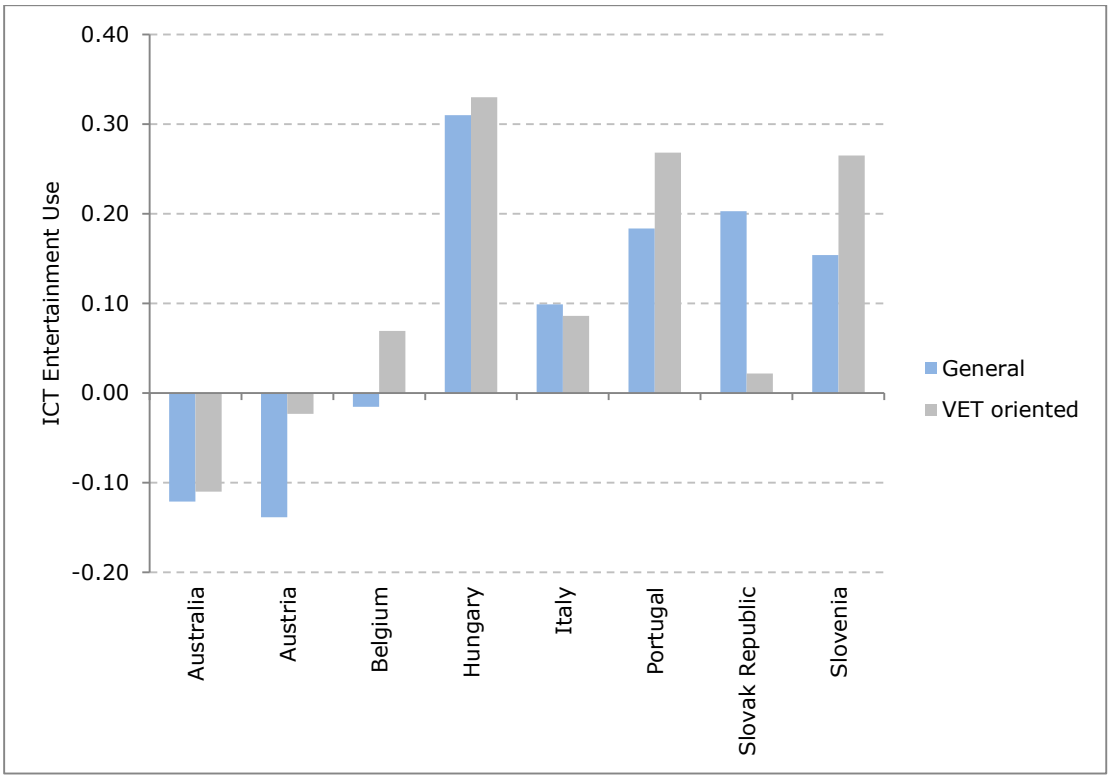


Source: CRELL analysis based on PISA 2012 CBA data. *See also Table 11, Annex A.*

Regarding the use of ICT for entertainment[7], the OECD (2014) created an index of ICT use based on activities such as browsing the internet for fun or download music, films, games or software. More positive values on this index indicate higher frequencies of ICT entertainment use.

Figure 12 shows that there is one group of countries – Austria, Belgium, Hungary, Portugal and Slovenia – where VET students use ICT for this purpose more than general education students do, although in Austria and in Belgium the frequency of ICT for entertainment is very low. In the Slovak Republic and Italy the opposite is true. In the benchmarking country, Australia, the value of this index is negative, but there is a very small difference between the uses of ICT for entertainment of VET versus general education students.

Figure 12. ICT use for entertainment for students in general and VET oriented programmes



Source: CRELL analysis based on PISA 2012 CBA data. *See also Table 12, Annex A.*

The index ICT at home for school related tasks[8] includes items answered by the students on activities done at home, such as preparing an essay or presentation, using email for communication with teachers, downloading material from the school's website and doing

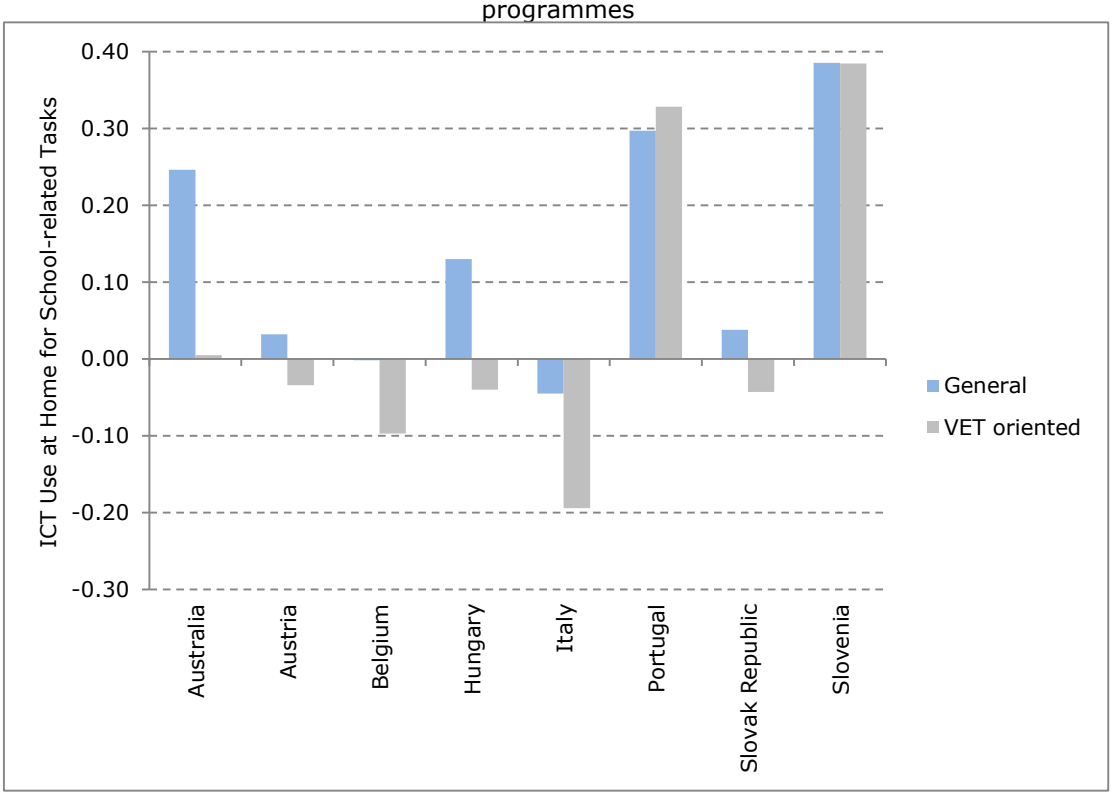
[7] More details can be found at http://www.oecd.org/pisa/pisaproducts/PISA-2012-technical-report-final.pdf on pages 339 and 340.

[8] More detailed information on this index can be found at http://www.oecd.org/pisa/pisaproducts/PISA-2012-technical-report-final.pdf on page 340.

homework on the computer, among others. More positive values on this index indicate higher frequencies of ICT use at home for school related activities.

The widest difference in the use of ICT at home for school related tasks for VET versus general students is found in Australia (figure 13). The EU Member States where this difference is also significant are Hungary, Italy, Belgium, and to a lesser extend Austria, Portugal and the Slovak Republic. In these countries VET oriented students report engaging less in these home tasks than general education students. In Slovenia, no difference in the use of ICT at home for school purposes was found.

Figure 13. ICT use at home for school related tasks for students in general and VET oriented programmes



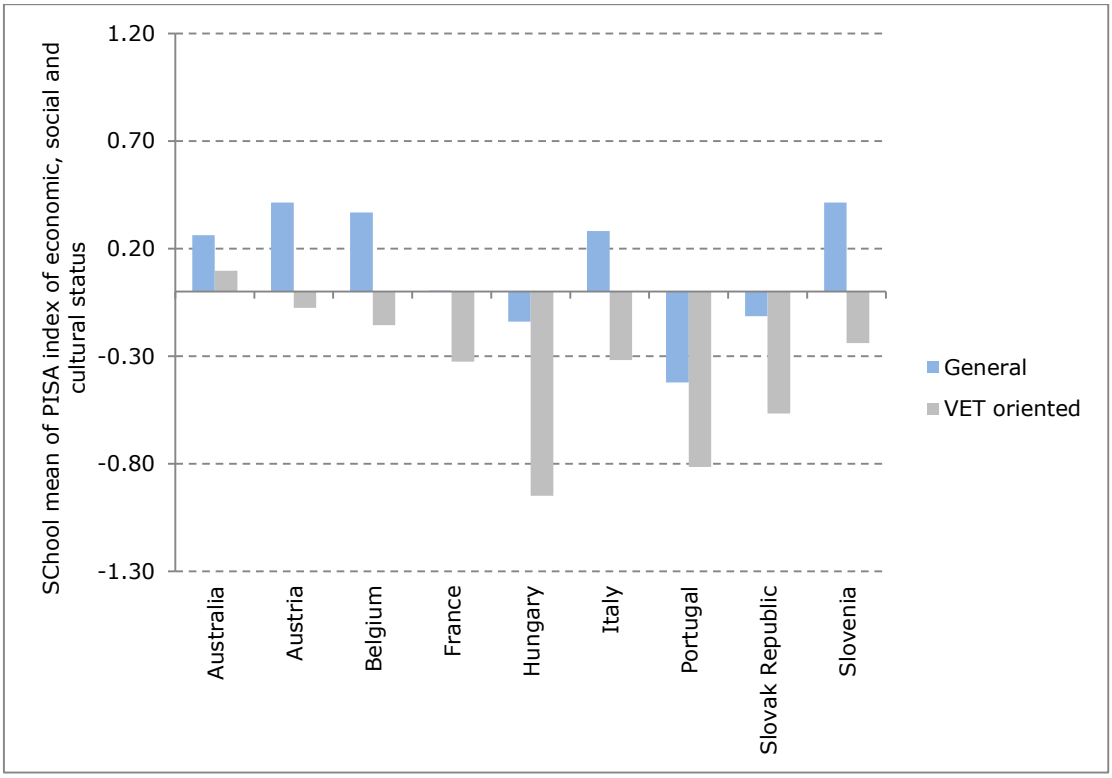
Source: CRELL analysis based on PISA 2012 CBA data. *See also Table 13, Annex A.*

3.5 ICT at school

3.5.1. School Socio-economic background

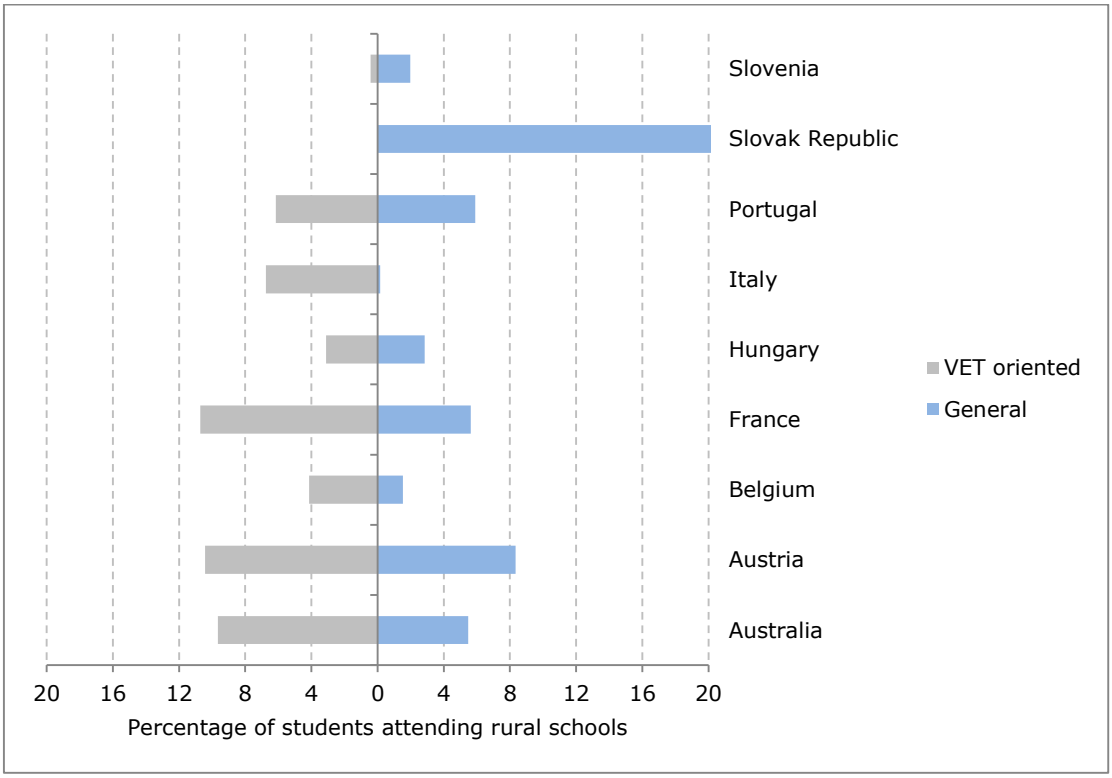
Across all countries, the school mean of ESCS is lower for VET students (figure 14). This indicates that a school´s socio-economic composition is always lower for VET students and that general education students are enrolled in schools with a more favourable socio-economic make up.

Figure 14. School mean of students´ ESCS by orientation of study



Source: CRELL analysis based on PISA 2012 CBA data. *See also Table 14, Annex A.*

Figure 15. Percentage of students attending rural schools by orientation of study

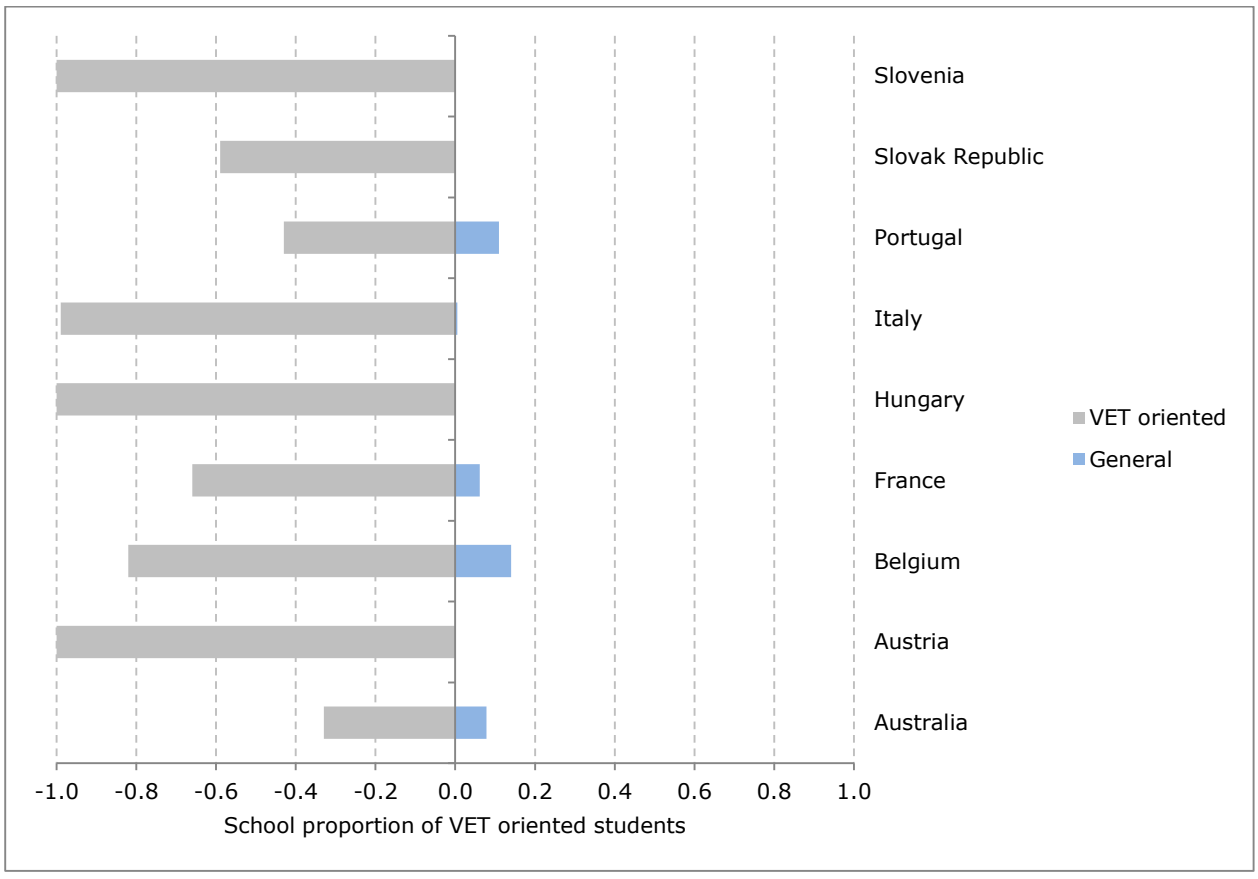


Source: CRELL analysis based on PISA 2012 CBA data. *See also Table 14, Annex A.*

The same overall pattern holds for school location (figure 15), except in the Slovak Republic and in Slovenia; VET students enrol more in rural schools than in urban schools, while the reverse is true for general education students.

Figure 16 illustrates the school proportion of vocational students by country. The results clearly show that the school proportion of VET students is much higher for students in vocational programmes. In particular, in Austria, Hungary, Italy and Slovenia vocational students are already attending specialised schools for their programme of study. This is indicative of horizontal stratification between schools. The graph also indicates that students in general programmes attend schools with a very low proportion of VET students.

Figure 16. School proportion of VET students by orientation of study



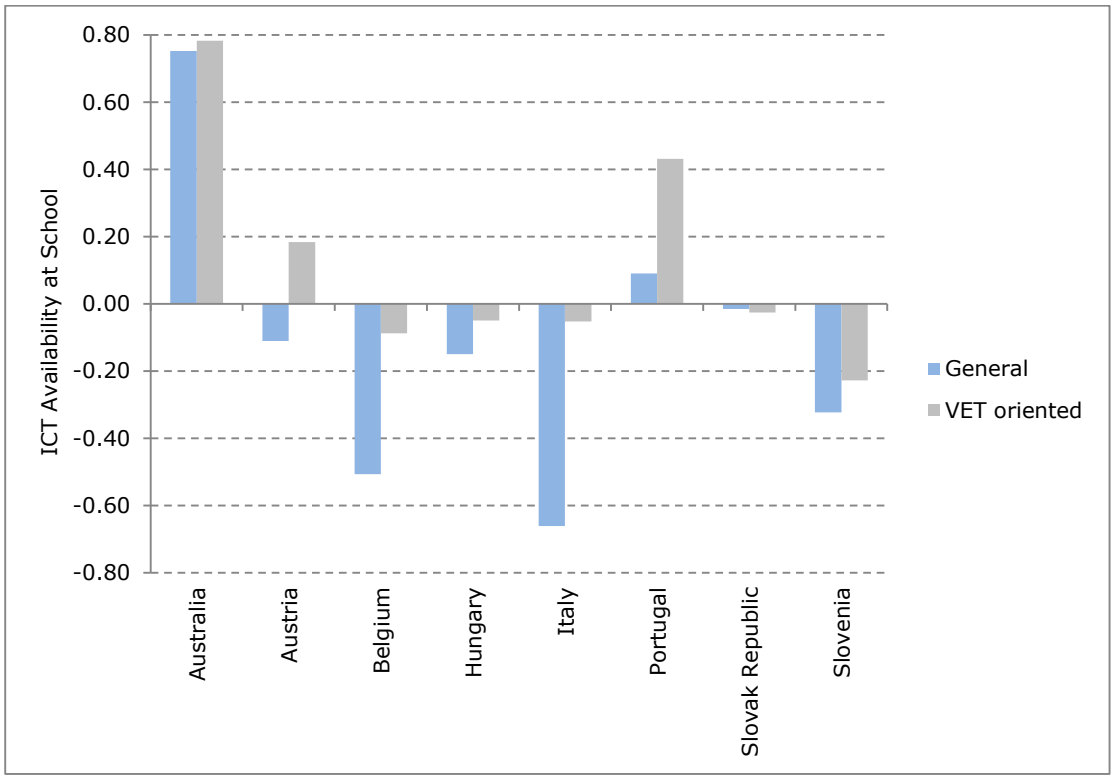
Source: CRELL analysis based on PISA 2012 CBA data. *See also Table 14, Annex A.*

3.5.2. ICT resources available at school

Regarding the ICT resources available at school[9], the OECD (2014) created an index based on the existence of devices at school for students' use. It includes information on the availability of a desktop computer, laptop, tablet, internet connection, printer and USB sticks. Higher positive values on this index indicate higher frequencies of ICT availability at school. Figure 17 shows that the availability of ICT at school for VET and general students registers a clear pattern across countries (Figure 17). In all countries, except in the Slovak Republic, VET students have more availability of computers at school.

Figure 18 shows that even when adjusting for socio-economic status (ESCS), in 5 out of 8 EU MS vocational oriented students have more availability of computers than do general education students. Only in Austria, Hungary and the Slovak Republic do general education students have more computers used for education at school than do general education students.

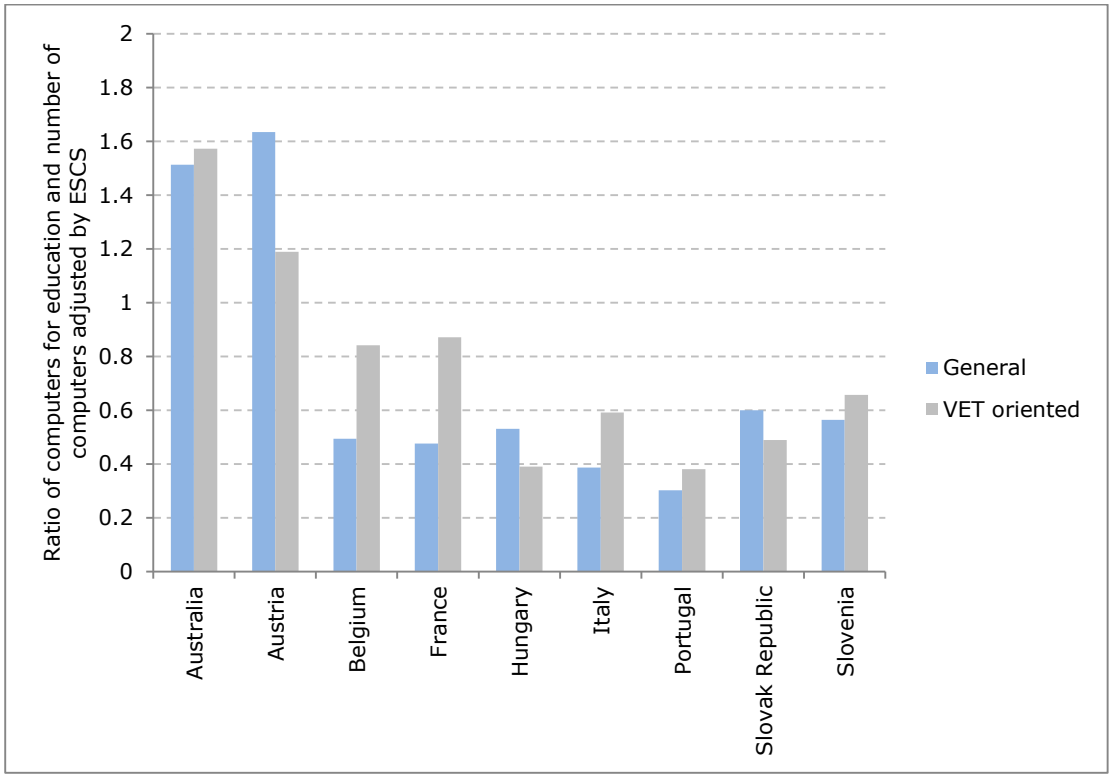
Figure 17. ICT availability at school by orientation of study



Source: CRELL analysis based on PISA 2012 CBA data. *See also Table 17, Annex A.*

[9] More details can be found at http://www.oecd.org/pisa/pisaproducts/PISA-2012-technical-report-final.pdf on page 339.

Figure 18. Ratio of computers for education and the number of computers adjusted by ESCS by orientation of study



Source: CRELL analysis based on PISA 2012 CBA data. *See also Table 18, Annex A.*

3.6. The navigation behaviour of students by orientation of study

In order to measure effective and ineffective navigation online, OECD constructed two indices to describe how students navigate websites when performing typical online reading tasks. The first index examines the amount of students' overall activity in terms of the total number of tabs and links visited, beyond the starting page, capturing the quantity of navigation. The index is named "index of overall browsing activity" and varies between 0 and 100 (0 indicating no activity and 100 indicating maximum activity)[10]. The second index called "index of task-oriented browsing" is related with the quality of navigation and examining the sequence of page views and distinguishing between task-relevant steps, missteps, and task-irrelevant steps within the navigation sequence" (OECD 2015, p. 112). This index captures whether students carefully select the links they follow, according to the demands of each task. The highest score of this index is

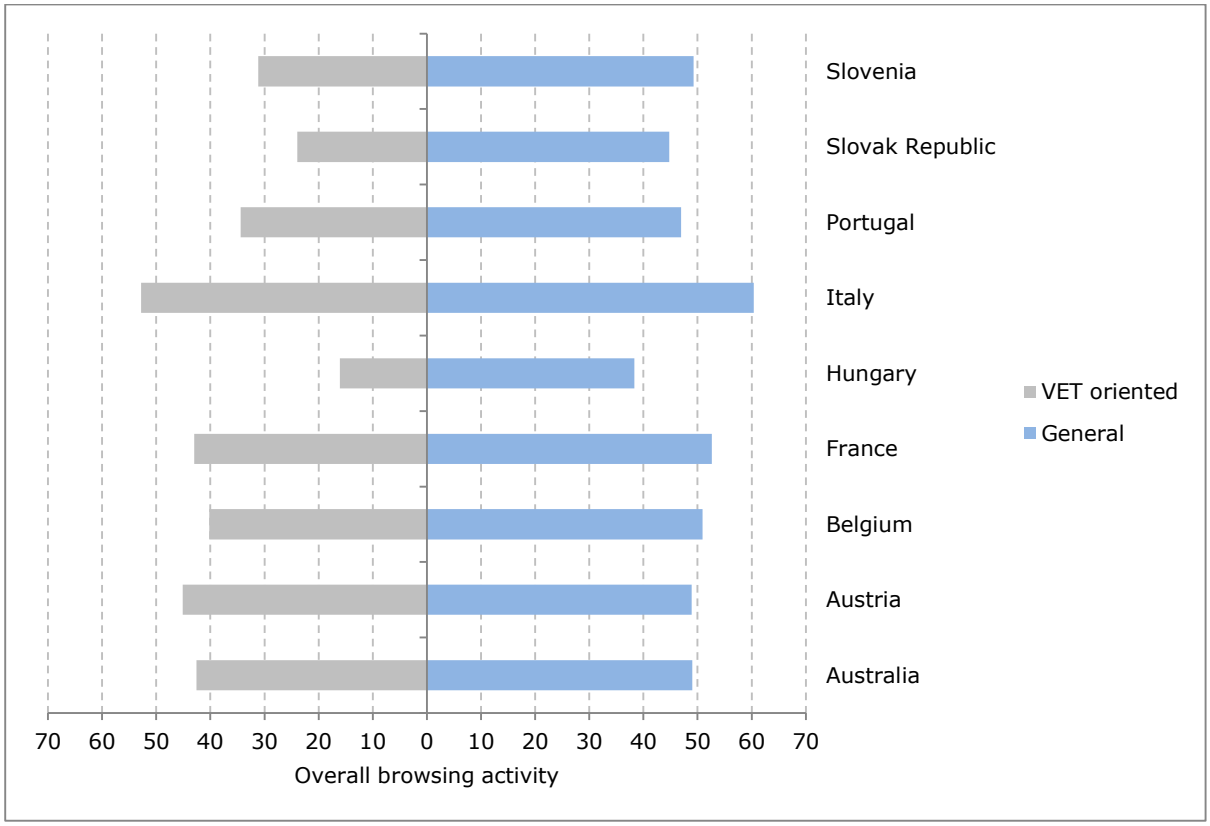
[10] "Very low scores on this index may indicate either lack of motivation, great difficulties in basic text-processing skills (e.g. understanding the purpose of a task) or lack of familiarity with the typical forms of hypertext encountered on line or with basic computer skills, such as using a mouse to navigate a webpage or scroll down a list."(OECD, 2015, p.112)

attained by the students who navigate websites by staying on the task-relevant track, and who persist in doing so until they reach the solution. The students who navigate in an unstructured way, and are easily distracted by task-irrelevant content, score the lowest on this index, followed by students with insufficient navigation activity.
There is considerable variation in the navigation behaviour of students across the countries that participated in the PISA assessment of digital reading (figures 19 and 20).

Not surprising, as shown in figure 19 given the low achievement of VET students, their overall browsing activity is lower when compared to the browsing activity of general education students. This is a consistent pattern across countries. This gap is wider in Hungary and in the Slovak Republic.

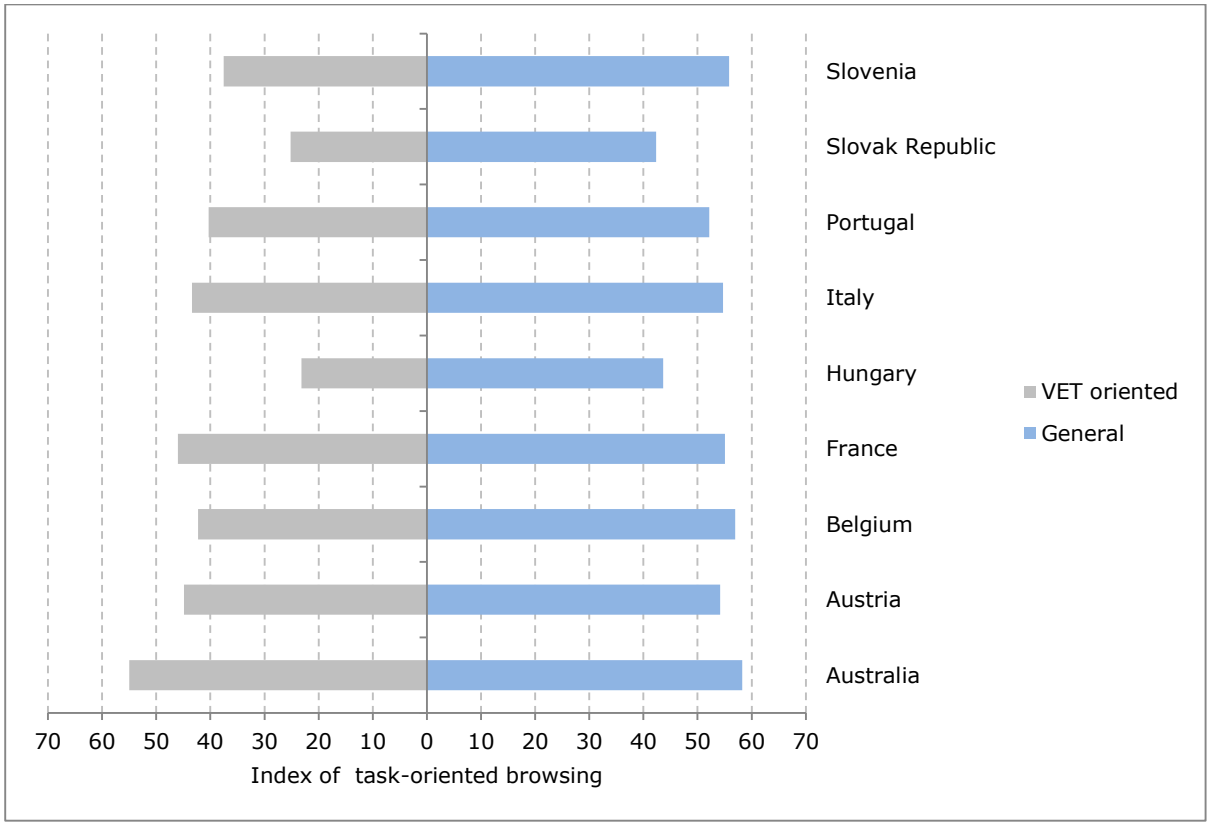
Similarly, as shown in figure 20, students´ task-oriented browsing activity is of less quality when compared to the browsing activity of general education students. The widest differences by orientation of study are found in Hungary and in the Slovak Republic. However, in Australia the gap is narrower than that registered for overall browsing.

Figure 19. Overall Browsing activity by orientation of study



Source: CRELL analysis based on PISA 2012 CBA data. *See also Table 19, Annex A.*

Figure 20. Task-oriented browsing by orientation of study



Source: CRELL analysis based on PISA 2012 CBA data. *See also Table 20, Annex A.*

3.6.1 The relationship between digital reading performance and students' navigation behaviour

Students' performance in print reading influences largely students' performance in digital reading (OECD, 2015). Findings from OECD showed that "in some countries/economies, average performance lies above or below the level that could be expected, given their students' performance in print reading" (OECD, 2015, p. 119). These differences are related to students' navigation behaviour. Figure 21 presents the explained variation in the digital reading performance according to students' navigation behaviour – quantified by the indices of overall navigation activity and task-oriented navigation activity – and their performance in print reading.

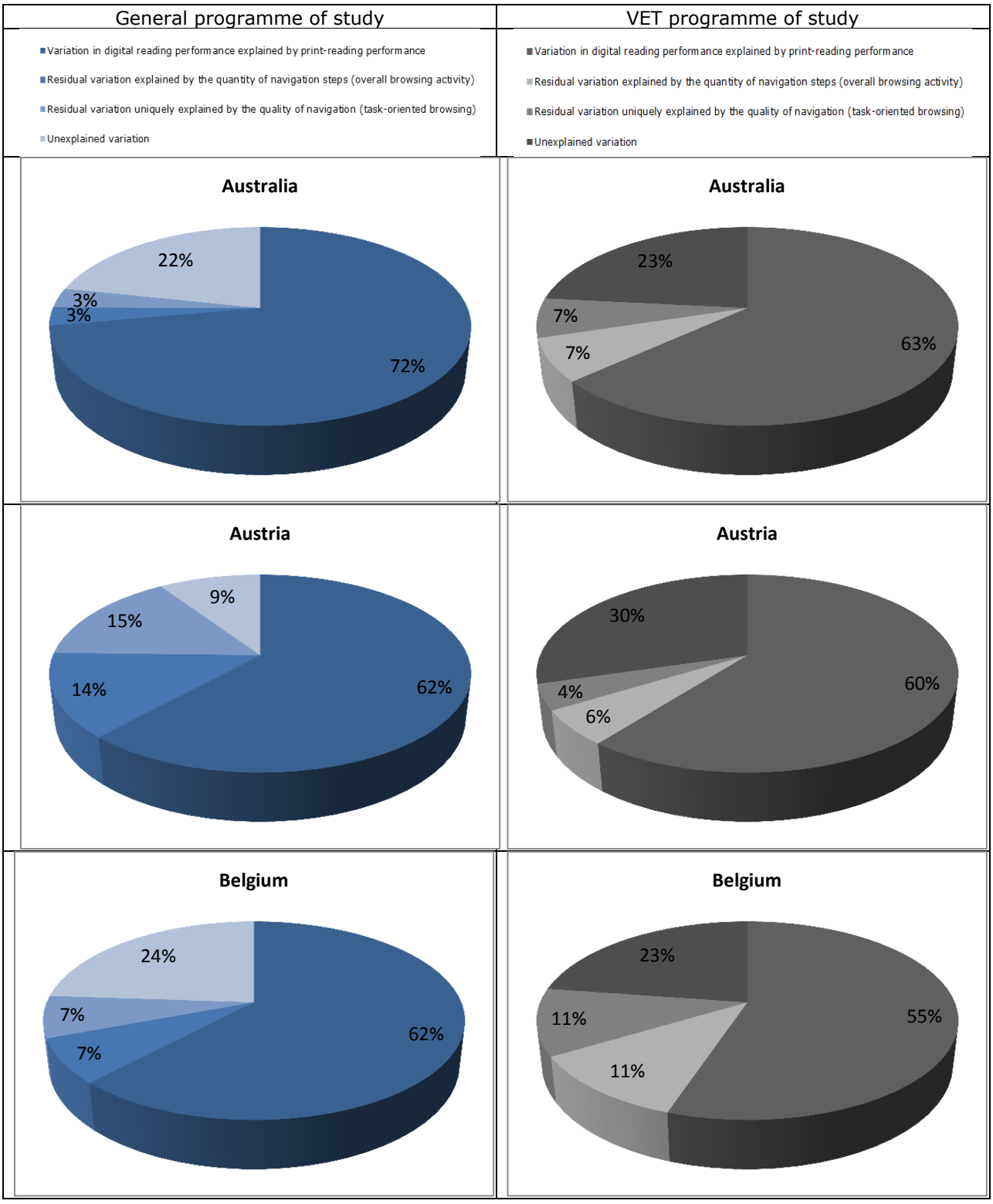
In all countries, students' navigation behaviour explains a significant part of the differences in digital reading performance between countries that is not accounted for by differences in print-reading performance in both orientations of study. In almost all countries, the percentage of explained variation of students' navigation behaviour is higher for VET oriented students than for students in general programmes, showing the great importance of this behaviour for vocational students. More precisely, for vocational students after controlling for differences in print reading, the quantity of navigation (as

measured through the *index of overall browsing activity*) accounts from 6% (in Austria) to 15% (in Portugal) of digital reading performance. The quality of students' navigation (as measured through the *index of task-oriented browsing*) explains from 4% (in Austria) to 11% (in Belgium, Italy and the Slovak Republic).

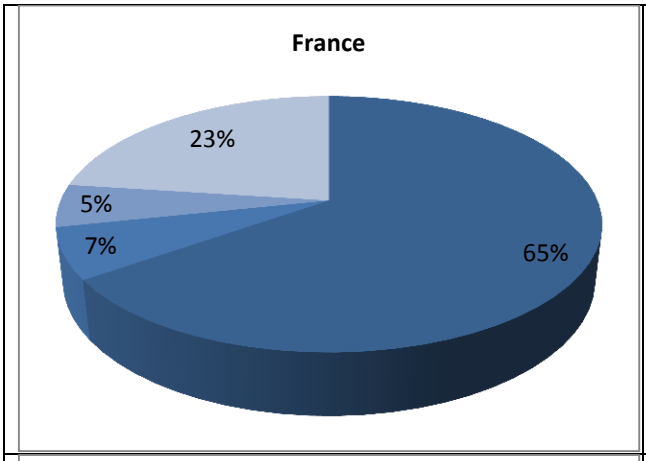
3.7 The relationship between print and digital reading performance

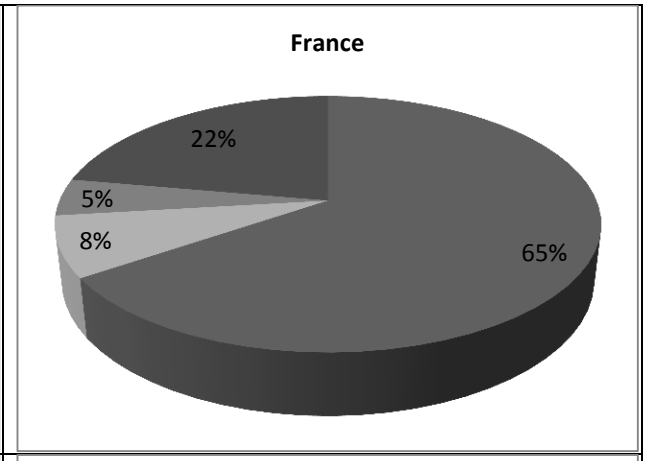
The graphs presented in figure 21 also show that the highest percentage of the variance in students' digital reading performance is due to their print reading skills. The percentage is consistently higher than 50%, irrespective of the programme of study, and this holds for all EU countries and for Australia. Only in Hungary for VET oriented students the percentage of variation explained is below 50%. This finding calls attention to the fact that system-level policies should target educational attainment, namely high reading performance in order to ensure quality and equity in education. This finding is in line with the results reported by the OECD (2015) indicating that most of the variation in digital reading achievement in PISA 2012 is explained by students' print reading. The analysis in this report shows that this is true for students in both general and vocational programmes of study.

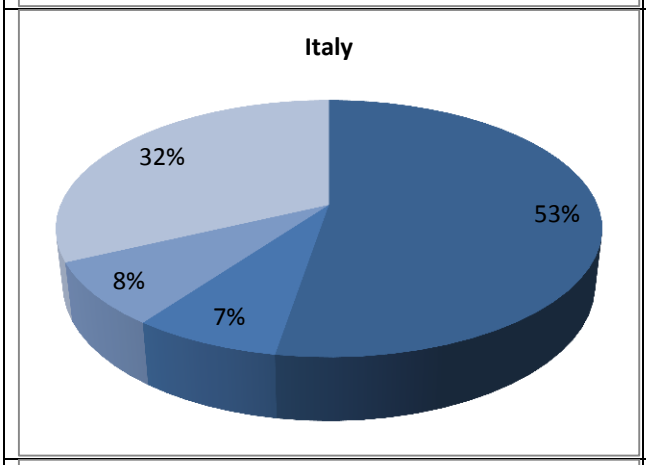
Figure 21. Explained variation in digital reading performance by orientation of study[11]

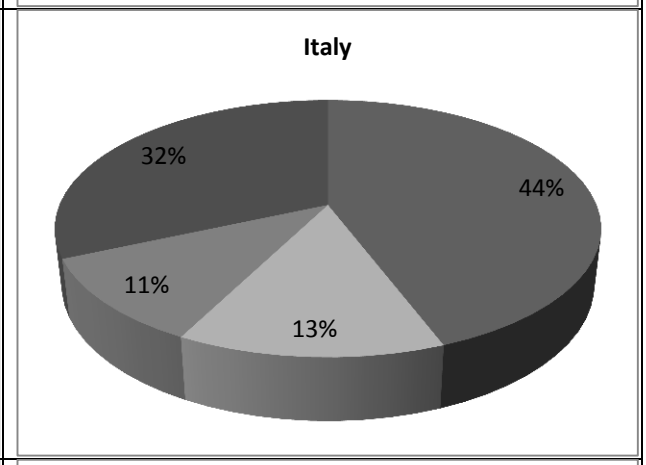


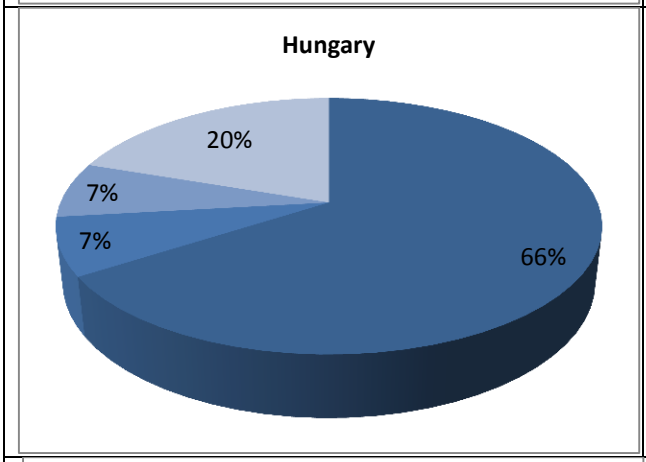
[11] The figure is based on results from regressions of countries' mean performance in digital reading on mean performance in print reading and average values for the two indices of navigation.

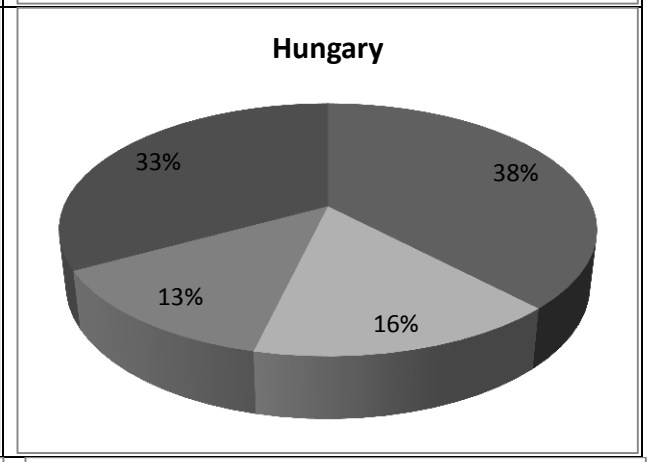

France
23%
5%
7%
65%

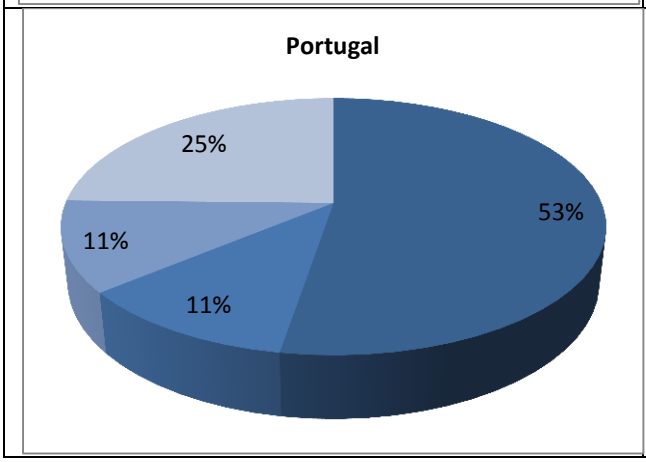

France
22%
5%
8%
65%

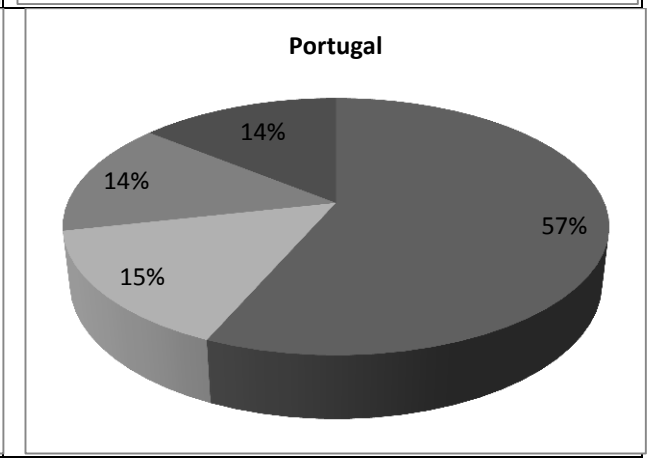

Italy
32%
53%
8%
7%

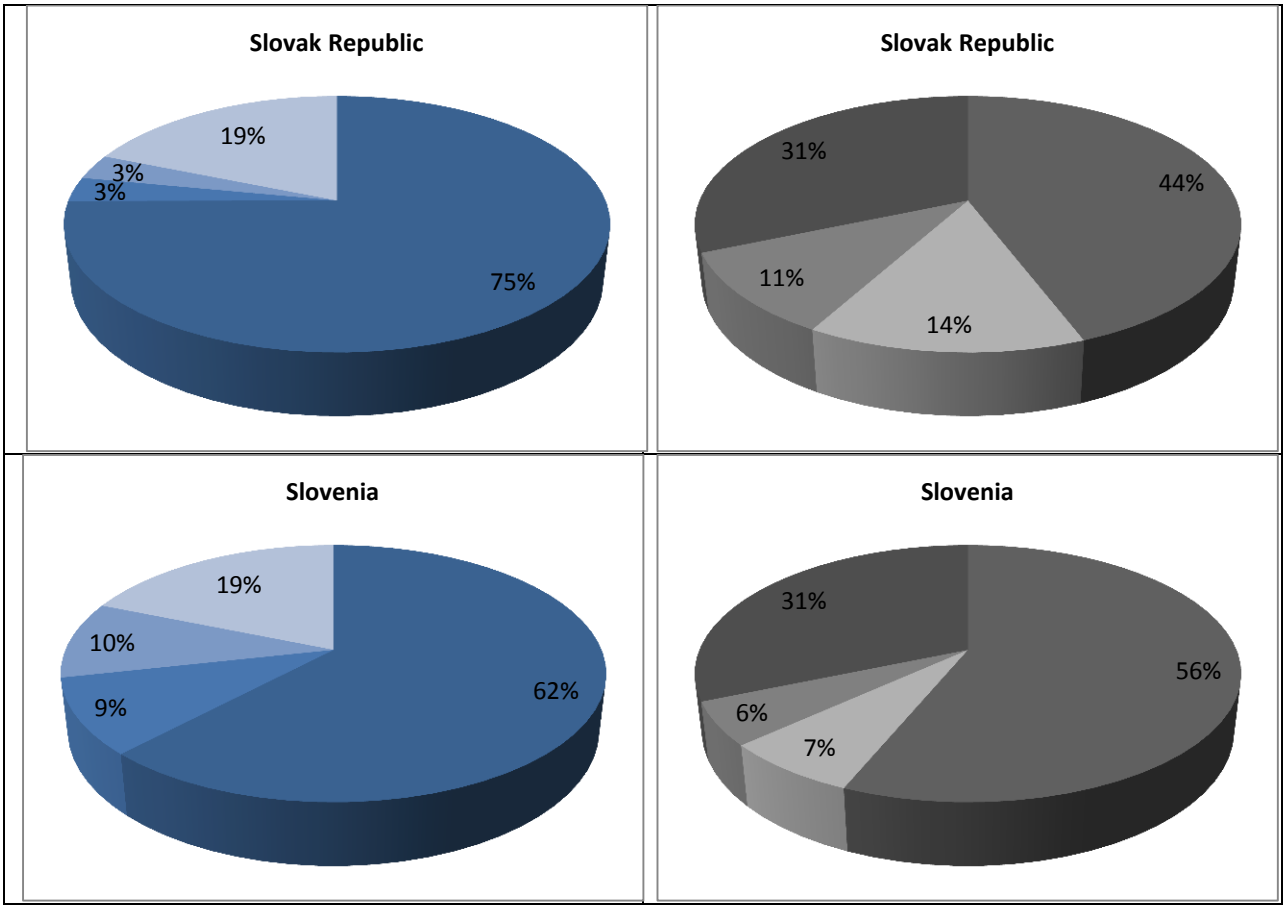

Italy
32%
44%
11%
13%


Hungary
20%
7%
7%
66%


Hungary
33%
38%
13%
16%


Portugal
25%
53%
11%
11%


Portugal
14%
14%
57%
15%



Source: CRELL analysis based on PISA 2012 CBA data. *See also Tables 21.1 and 21.2, Annex A.*

Highlights from this part

- Reading performance
  - In all countries analyzed most of the variation in digital reading achievement is explained by students' print reading.
  - VET students perform better in digital reading than in print reading in Belgium, France, Italy, Portugal and the Slovak Republic.
  - For VET oriented students the gender gap tends to be wider both in digital and print reading.
  - The percentage of low achievers in reading is higher for VET oriented students than for students in general programmes of study.

- Background variables
  - There are more socio-economically (ESCS) disadvantaged students in VET oriented programmes than in general programmes and VET students have less access to computers at home.
  - VET students have more access than general education students to internet at school.
  - Across all countries, the school mean of ESCS is lower for VET students.
  - VET students enroll more in rural schools than in urban schools, while the reverse is true for general education students.

- ICT usage
  - VET students tend to browse the internet for school work more than general education students.
  - VET students use ICT for school-related tasks more than general education students.
  - VET students use ICT for entertainment more than general education students.

- Browsing quantity and quality
  - The overall browsing activity of VET students is lower when compared to the browsing activity of general education students.
  - The task-oriented browsing activity of VET students is of less quality when compared to the browsing activity of general education students.
  - In almost all countries, the percentage of explained variation of students' navigation behavior in digital reading skills is higher for VET oriented students than for students in general programmes.

PART IV

The relationship between digital reading performance and programme of study

In this section, we describe the results of a multilevel analysis considering variables at the student level and at the school level, with students' PISA scores in digital reading as the outcome measure. The use of multilevel techniques allows for the estimation of student and school level effects on students' reading performance. Variables measuring students' socio-economic background and ICT resources at home as well as variables assessing students' ICT use and attitudes are included in the model. As for the school level variables, the model includes variables related with ICT use and availability, and school composition and location.

This section aims at answering the following research questions: 1) Is there a portion of the variance in students' digital reading performance attributed to differences between schools for students in general and VET oriented programmes of study? 2) What is the relationship between students' ICT use and attitudes and students' performance in digital reading for students in General programmes of study? 3) What is the association between students' ICT use and attitudes and students' performance in digital reading for students in VET oriented programmes?

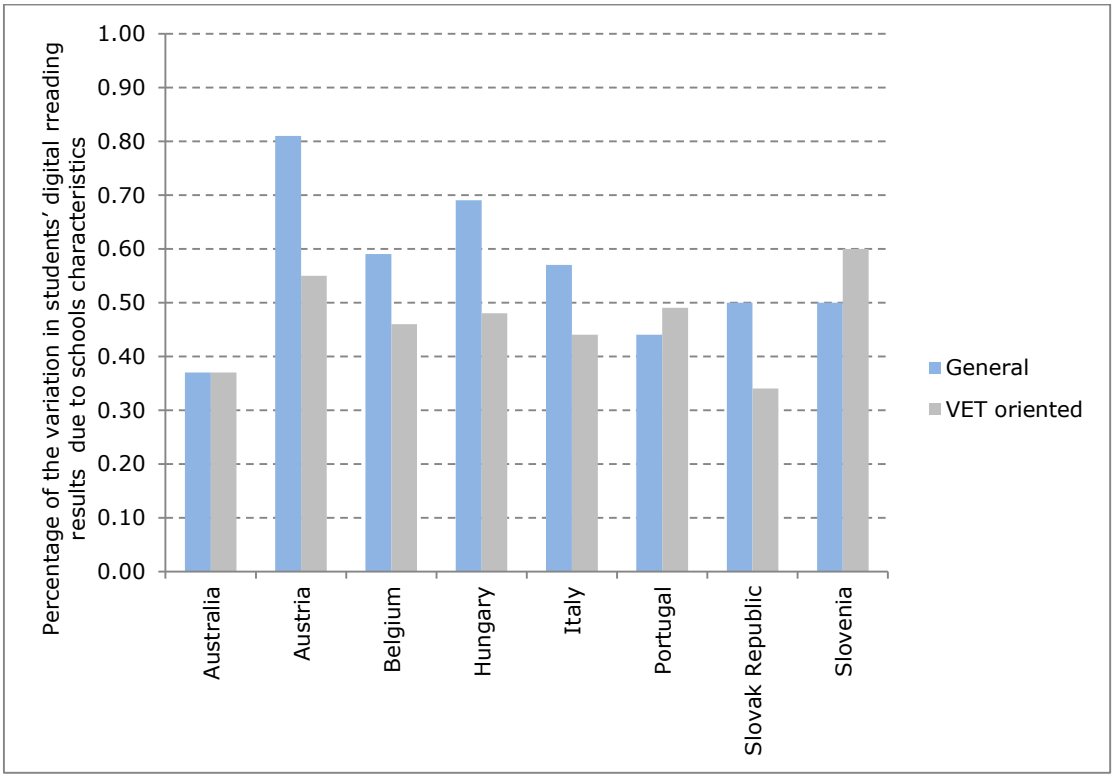
In order to answer these questions, we use PISA 2012 data for the following EU Member States[12]: Austria, Belgium, Hungary, Italy, Portugal, the Slovak Republic and Slovenia. Additionally, Australia is included in the analyses as a benchmarking country.

To answer the first research question, we ran a multilevel null model for each country. This model contains only the dependent variable; the students' scores in digital reading and doesn't include covariates other than a constant. The null model allows for obtaining the proportion of variability, calculated using the variances estimated for the errors, between students within schools and between schools. That is, the multilevel model indicates which proportion of variation can be attributed to the school level. This information can then be used to address what is malleable to change in schools and propose policy reforms.

The results (Table 1 in Annex B and figure 22) show that, for students in general programmes of study the proportion of variability of students' digital skills between schools varies from 0.37 in Australia to 0.81 in Austria, which indicates that 37% of the total variability in digital reading skills in Australia is between schools and that, in Austria a very large percentage of the variation in students' digital reading skills is due to school characteristics. School variance is not that high for students in VET oriented programmes; varying from 0.34 in the Slovak Republic to 0.60 in Slovenia. In Portugal and Slovenia the percentage of the variation in students' digital reading skills due to school characteristics is higher for students in VET oriented programmes than for students in general programme. The variability between schools for students in VET and general programmes has the same magnitude only in Australia. These results show that, for students in both general and VET programmes in the countries under study, there are considerable differences among schools in the reading digital performance of their students that can be explained by school-to-school differences.

[12] As previously mentioned, there are no data for France available for the ICT familiarity questionnaire.

Figure 22. Percentage of variance in students´ digital skills between schools by orientation of study



Source: CRELL analysis based on PISA 2012 CBA data. *See also Table 1, Annex B*

In order to answer the second and third research questions, on the relationship between students' ICT use and attitudes and students' performance in digital reading, a multilevel[13] model was used by aggregating data[14] from the **7 EU countries** under analysis - Austria, Belgium, Hungary, Italy, Portugal, the Slovak Republic and Slovenia (the "EU7"). In addition, we also present the analysis for **Australia** as a benchmarking country. Both for the aggregated data and for Australia, two analyses were carried out; one using the sample of students in general programmes of study and another one for VET oriented students.

Due to the hierarchical structure of the data (students within schools) a multilevel regression analysis (Goldstein, 2003) including information from the student and from the school was implemented. A two-level analysis was performed using MLWIN version 2.35, with students at level one and schools at level two. The regression coefficients of the multilevel models indicate the estimated effect of the variables (predictors) on the outcome variable (students' digital reading performance). In particular, the magnitude and the direction of the coefficients, as well as the significance of the difference from

[13] The variance components' model was used and the model was then estimated using iterative generalized least squares (Goldstein, 1986). The missing values were excluded from the analysis.
[14] Country dummy variables were used to control for country heterogeneity.

zero, show the relationship between the predictor and achievement, keeping all the other predictors in the model constant.

At the students´ level, variables measuring **students' experience and ICT use** were considered in the model, namely; practicing and drilling at school, browsing the internet for school work at school, chatting on line at school, using email at school, overall browsing activity, task-oriented browsing, ICT entertainment use and ICT use at home for school related tasks. Students´ print reading performance was also included in the model, as it explains variability in digital reading performance. Additionally, the analysis controls for a set of socio-economic characteristics to account for the role of other student key background factors. More specifically, the background factors include gender, immigration background, socio-economic status (ESCS), and students´ ICT availability at home. At the school level, the following variables were included in the model: School average of students´ socio-economic status, ICT availability at school, school location, school proportion of VET oriented students.

Table 1 indicates the statistically significant results[15] found for the EU7 and Australia, according to different programmes of study. Blue cells indicate a positive significant coefficient and yellow cells are for a negative statistically significant coefficient. A darker tone indicates that the relationship with students' digital reading performance is stronger.

The multilevel analysis reveals that independently of the programme of study, students' print reading performance is positively associated with students' digital reading skills also when considering clustering of students within schools. This is true for Australia and this finding is consistent for the EU7 as well.

In what concerns student variables, for the aggregated EU countries there is a positive significant coefficient of the variable task-oriented browsing for students in general and vocational programmes. This indicates that students with higher quality of task oriented navigation present better results in digital reading. The same is true for the quantity of navigation, measured through the index of overall browsing activity. Regarding students' use of ICT in Australia, the results reveal that there is a positive association between students' digital reading performance and quality and quantity of navigation. This is true both for students in general programmes and for vocational students.

[15] Both for the EU7 and Australia analyses, as well considering students from general and VET studies of programmes, comparing the null model with the final models there is a clear reduction of the deviance. The variance component between students and between schools diminished significantly in all models, indicating the adequacy of our model to explain students' digital reading performance.

Table 1. Model summary

		Australia		EU7 countries (aggregated)	
		General	**VET oriented**	**General**	**VET oriented**
Student level variables	Print reading score				
	Gender (female)				
	Non-immigrant background				
	ESCS (Socio-economic Status)				
	Students ICT availability at Home				
	Practicing and drilling at school				
	Browsing the internet for school work at school				
	Chatting online at school				
	Using email at school				
	Overall browsing activity				
	Task-oriented browsing				
	ICT entertainment use				
	ICT use at home for school related tasks				
School level variables	School average of students' ESCS				
	ICT availability at school				
	Rural school (school location)				
	School proportion of VET oriented students				

Source: CRELL analysis based on PISA 2012 CBA data. *See also Table 2, Annex B*

Additionally, ICT use for entertainment is also an important factor that affects students' digital reading performance, showing that both students in general and vocational programmes that report using ICT for entertainment purposes present better results in digital reading. Importantly, these findings are independent of the programme of study, except for Australian students in VET programmes. Concerning the variables measuring ICT related tasks performed on school computers, practicing and drilling is negatively associated with digital reading performance in the EU7 model for students attending general programmes. For Australian students in general programmes browsing the internet at school for school work has a positive relationship with students´ digital reading performance. The same is true in the EU7 model independently of programme of study. In contrast, chatting on-line at school is negatively associated with digital reading performance in Australia for students in general programmes.

In what refers to ICT use for school related tasks, there is a negative association between the uses of ICT at home for school work and digital reading performance for vocational and general students in the EU 7 data. In Australia students attending general programmes using ICT at home for school related activities present better results in digital reading.

Regarding ICT resources at home and at school, students ICT availability at home has a negative relationship with vocational students' digital reading performance in the EU7 model. In Australia no influence of ICT resources on digital reading performance was found.

Concerning students' background factors, table 1 shows that in the EU7 model girls perform better in digital reading than boys, both in general and in vocational education. In Australia, native students attending general programmes of study perform better than immigrants.

Students´ socio-economic status is positively associated to students' digital reading performance in EU MS for students enrolled in general programmes.

In what concerns other school level variables, the results show that the most significant positive finding related to students´ digital reading performance is the school average of ESCS. This is true for students in the EU7 countries, irrespective of the programme of study, and also for Australian students attending general programmes.

Finally, in the EU7 model school location does not relate to digital reading performance. However, Australian students attending schools located in rural areas perform worse than the ones attending schools located in cities or towns. This is true for students attending either general programmes or vocational programmes of study.

Considering the strength of the relationship between student and school factors influencing students' digital reading performance, table 2 in Annex B shows that the strongest association between print reading performance and digital reading performance is found for students in general programmes of study, while in Australia this association is stronger for vocational students. The relationships between the quality and quantity of internet navigation and digital reading performance are stronger for vocational students both in the EU7 model and in Australia. Concerning the strength of the relationship between the use of ICT for entertainment and students digital reading performance the results reveal that the strongest association is found for vocational students in the EU7. The strongest relationship between students´ socio-economic status and students' digital reading performance is found in the EU7 model for the students enrolled in VET programmes. Finally, with respect to gender and country of birth and

their relation with digital reading performance we find that there are strong realtionships for students in general programmes of study in the European model.

Comparing the null model and the final model (Table 2, Annex B), the results show that the school level variables for the EU model explain 88% and 82% of between school variation in digital reading results, for students in general programmes and for students in vocational programmes, respectively. In what concerns student variables related to ICT use and availability as well as the control variables, the model accounts for 62% and 64% of variation in students digital reading performance, for students in general and in vocational programmes, respectively. With respect to Australia, the variation of digital skills for students in general and in VET programmes attributed to school characteristics is 76% and 74%, respectively. As for student characteristics and their relation with variation in digital skills, the variation explained is 81% independently of the programme of study.

Highlights from this part

School vs student level characteristics

- In all EU MS school differences explain part of the variance in digital skills for students in general and vocational programmes of study.

EU7 aggregated model

- Print and digital reading performance
  - Students' print reading performance is positively associated with their digital reading performance, irrespective of the programme of study.
- Background variables
  - Students attending schools with a higher ESCS average perform better in digital reading. This is irrespectively of the programme of study in the EU7 model. However, in Australia this is only true for students in general programmes.
  - In Australia attending schools in rural areas is negatively associated with students' digital skills, irrespective of the programme of study, but there is no negative association in the EU7 model.
- ICT uses
  - ICT use for entertainment is positively related with students' digital reading performance, independently of programme of study in the EU7 model. In Australia this is true for students in general programmes.
  - For the EU7 model, practicing and drilling at school is negatively related with the digital skills of students attending general programmes.
  - Browsing the internet at school for school work has a positive association with digital skills for vocational students in the 7 EU model and for general education students in Australia.
  - Use of ICT at home for school work and ICT availability at home have a negative relationship with digital reading performance for vocational students in the EU7 model. The same is true for the use of ICT at home for school related tasks for European students attending general programmes.
- Browsing quality and quantity
  - Students' navigation behaviour in terms of quality and quantity has a positive relationship with students' digital skills in both programmes of study.

CONCLUSION AND DISCUSSION

This section summarizes the findings in terms of differences in digital and print reading performance by programme of study and discusses implications for policy.

The analyses presented in this report were motivated by the OECD (2015) findings that part of the variation in the digital reading performance of 15-year-old students in PISA 2012 is due to differences between schools. Our results add to this evidence by showing that this variation also holds when considering the digital reading performance of students in different programmes of study: vocational versus general programmes. Our multivariate analysis reveals that there are considerable differences among schools in the digital reading performance of their students that can be explained by school-to-school differences.

In general, our analyses also shows that students in VET programmes tend to perform better in digital reading than in print reading. This is in contrast with the patterns found by OECD when considering all students, irrespective of programme of study (OECD, 2015). When undifferentiated by programme of study, findings indicate that students perform better in digital than in print reading only in France, Italy and the Slovak Republic (OECD, 2015). Our results extend this to Belgium and Portugal. Thus, in five out of the seven European countries analyzed vocational-oriented students perform better in digital reading than in print reading.

Results also suggest that the gender gap is wider for VET students, when compared to that of students attending general programmes, both in digital and print reading. As such, reducing this gap is important to create equal gender opportunities for all students, but especially for VET students. Similarly, as our analyses show, there is a gap between more and less economically advantaged populations when it comes to ICT availability at home. This can be addressed by policies that make computers at school available for VET students to compensate for reduced access to computers at home for these students. Since VET students have less access to computers at home, ensuring availability at school can be an effective substitution policy. This can help integrate students in the economic, social and cultural live of present-day knowledge societies[16]. Nonetheless, the advantages associated with computer access can only be fully realized if the ability to use digital tools is not an end in itself, but rather the focus of pedagogical practices that are conducive to students' learning.

Evidence shows that students' navigation behaviour predicts online reading performance beyond print reading skills (OECD, 2015), which supports the notion that the type of navigation makes a difference in performance. Our work is in line with this finding from OECD and adds information on the differentiation by program of study. We found that in almost all countries, the percentage of explained variation of students' navigation behaviour in digital reading skills is higher for VET oriented students than for students in

[16] See http://oecdeducationtoday.blogspot.it/2015/09/students-computers-and-learning-wheres.html

general programmes, which reveals the great importance of this behaviour for vocational students. In addition, we found that the overall browsing activity of VET students is lower when compared to the browsing activity of general education students. Moreover, the task-oriented browsing activity of VET students is of less quality when compared to the browsing activity of general education students. This suggests that schools have a role to play in helping VET students develop the ability to learn how to use digital tools; how to plan and execute searches and judge the usefulness of the information found, for example.

Importantly, as Hatlevik, Guomundsdóttir and Loi (2015) highlight, the development of digital competences requires strategic use of digital information. As they state, "digital skills and competences require hard work and persistence as does developing other key competences such as reading, writing, or doing calculations (p. 133)". In this sense, school policies that encourage teachers to guide students' learning by showing them how to navigate digital environments to obtain information should be encouraged. In particular, frequently browsing the internet for school work at school can be beneficial for students attending VET oriented programmes. In contrast, engaging students in drilling exercises may not be such an effective practice to increase reading performance. In our analysis, and in line with the findings by Falck, Mang and Woessmann (2015) regarding mathematics achievement, the reading achievement of general education students is negatively related to this practice. This is confirming evidence that spending time on the computer to do drilling exercises at school is negatively related with achievement, but no significant relationship was found for VET students. This discussion is highly relevant as we now know more about ICT-related practices and their relation with students´ attainment. It may be that for low achievers, of whom many are VET students, this practice has no relation with achievement. Future studies should further address the use of different pedagogical practices to determine their influence on students´ achievement.

The finding that the use of ICT at home for school work and ICT availability at home have a negative relationship with digital reading performance for VET students seems at odds with the notion that availability and use correlate with higher achievement. In Australia the opposite relationship holds; ICT at home for school work can be beneficial for the digital skills of Australian students, irrespective of program of study. This may be related to greater ICT availability and use in Australia and suggests that that less familiarity with computers and/or lack of guidance in using ICT may explain the results in European countries. In contrast, ICT use for entertainment is positively related with students' digital reading performance in the EU7 model. Perhaps VET students are more independent to perform these activities at home, without adult guidance. Regardless of

this possible explanation, our findings are in line with evidence from PISA 2009 data showing the positive association between ICT use and enjoyment activities, such as playing computer games, and students' achievement (Biagi & Loi, 2013). The index used in our study includes other activities than playing games. Thus, it would be ideal for future studies to assess which specific ICT enjoyment activities can contribute to the development of digital competences and to student learning.

Interestingly, this study of the differences in digital versus print reading achievement for students in different programmes of study highlights that digital reading may be a privileged way to help VET students increase their reading performance. VET students are more represented at the lower end of the reading achievement distribution vis a vis general education students. Thus, VET students start from a different point but they will have to use their reading skills in the professional contexts for which their vocational orientations of study prepare them for. Thus, using digital supports at school may be an optimal avenue to help them develop the stock of reading skills necessary for their future integration in the labour market.

Our findings also show that schools' socio-economic composition is important for digital reading performance. This is in line with the studies revealing that the socioeconomic composition of schools is related to students' achievement in general (Martin, Foy, Mullins, & O' Dwyer, 2013; Stancel-Piatak, Mirazchiyski & Desa, 2013). To address this, equity measures can be implemented by national governments, such as the promotion of social and economic diversity in schools to reduce the school compositional effects identified in this study and in previous research (Bellin, Dunge & Gunzenhauser, 2010).

Finally, in contrast with the benchmarking country – Australia – the socioeconomic composition of schools seems to matter in Europe, but location is not related with achievement. This suggests that in Europe, or at least in the 7 EU model, there is equity in educational opportunities related to ICT availability in urban and rural areas.

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ANNEXES

Annex A[17]

Table 1. Performance in digital and print reading in 2012

	Mean Score		N
	Digital Reading	**Print Reading**	
Australia	521	512	14481
Austria	480	490	4755
Belgium	502	509	8597
Denmark	495	496	7481
Estonia	523	516	4779
France	511	505	4613
Germany	494	508	5001
Hungary	450	488	4810
Ireland	520	523	5016
Italy	504	487	5495
Poland	477	518	4607
Portugal	486	488	5722
Slovak Republic	474	463	4678
Slovenia	471	481	5911
Spain	466	486	10175
Sweden	498	483	4736

[17] - In Annex A the analyses took into account the complex PISA design. Weights, replicate weights and/or plausible values were used when necessary.
- For the percentages (%) presented the missing values were excluded from the analysis.
- SE means standard error.

Table 2. Performance in digital and print reading of students in general and VET oriented programmes programmes and percentage of students in VET programmes

	General								VET oriented							
	Digital Reading					Print Reading			Digital Reading					Print Reading		
	%	**N**	**Mean score**	**SE**	**Stand. Dev.**	**Mean score**	**SE**	**Stand. Dev.**	**%**	**N**	**Mean score**	**SE**	**Stand. Dev.**	**Mean score**	**SE**	**Stand. Dev.**
Australia	89	12696	524	2	97	516	2	98	11	1733	491	4	90	481	3	86
Austria	31	1454	498	9	133	527	6	93	69	3301	472	4	87	473	3	86
Belgium	56	4885	537	3	88	552	3	89	44	3712	458	4	95	454	3	91
France	85	3968	519	4	96	517	3	107	15	645	464	9	91	441	8	96
Hungary	86	4105	470	4	103	504	3	86	14	705	331	11	88	396	7	68
Italy	48	2408	537	5	84	529	3	88	52	3087	474	7	95	450	2	90
Portugal	83	4833	499	4	83	503	3	86	17	889	419	7	88	412	6	93
Slovak Republic	89	2958	483	3	99	471	5	110	11	375	384	12	79	365	13	76
Slovenia	47	2185	527	3	79	534	3	78	53	3726	422	1	87	435	1	77

Table 3. Performance in digital and print reading of students in general and VET oriented programmes by gender

Country	Gender	Study orientation	Digital Reading score	Print Reading Score
Australia	Female	General	540.57	533.46
		VET oriented	503.36	497.02
	Male	General	509.11	498.70
		VET oriented	479.62	468.26
Austria	Female	General	506.49	540.02
		VET oriented	486.64	491.79
	Male	General	488.57	511.98
		VET oriented	458.21	455.42
Belgium	Female	General	545.70	561.92
		VET oriented	470.07	469.48
	Male	General	527.99	540.51
		VET oriented	447.72	440.40
France	Female	General	527.94	535.34
		VET oriented	478.59	465.92
	Male	General	509.74	496.44
		VET oriented	453.46	423.13
Hungary	Female	General	481.73	519.85
		VET oriented	331.42	402.52
	Male	General	456.49	485.08
		VET oriented	330.60	391.83
Italy	Female	General	538.25	538.59
		VET oriented	478.25	467.42
	Male	General	534.06	513.47
		VET oriented	471.27	439.11
Portugal	Female	General	504.25	518.42
		VET oriented	427.71	432.61
	Male	General	493.85	486.14
		VET oriented	413.90	399.84
Slovak Republic	Female	General	490.72	488.88
		VET oriented	360.79	360.75
	Male	General	475.02	453.34
		VET oriented	393.69	366.84
Slovenia	Female	General	535.37	551.19
		VET oriented	439.38	461.02
	Male	General	516.44	511.90
		VET oriented	409.99	416.62

Table 4. Percentage of low achievers in general and VET programmes of study for digital and print reading

		Digital reading score		Print reading score	
		%	**N**	**%**	**N**
Australia	General	11.85	1895	13.62	2081
	VET oriented	16.99	379	19.36	429
Austria	General	16.74	170	12.29	116
	VET oriented	21.78	748	22.84	767
Belgium	General	8.62	373	6.94	294
	VET oriented	28.13	991	27.93	1020
France	General	12.23	456	16.35	617
	VET oriented	22.31	146	33.8	216
Hungary	General	24.40	836	13.79	402
	VET oriented	80.97	565	56.13	394
Italy	General	7.26	143	9	176
	VET oriented	23.61	780	31.04	982
Portugal	General	14.24	755	13.53	708
	VET oriented	43.79	380	45.96	428
Slovak Republic	General	20.96	578	26.78	735
	VET oriented	60.64	240	71.26	272
Slovenia	General	8.1	136	6.89	102
	VET oriented	40.12	1732	33.96	1553

Table 5. Percentage of low achievers by gender in general and VET oriented programmes in digital reading and print reading

			Digital Reading			Print Reading		
Country	**Study orientation**	**Gender**	**N**	**%**	**SE**	**N**	**%**	**SE**
Australia	General	Female	672	7.82	0.55	716	8.66	0.63
		Male	1,223	15.70	0.75	1,364	18.35	0.72
	VET oriented	Female	127	12.63	1.84	137	13.52	1.48
		Male	252	20.69	2.22	292	24.32	2.11
Austria	General	Female	82	14.50	2.78	49	9.40	1.94
		Male	88	19.48	3.86	67	15.83	3.17
	VET oriented	Female	260	15.83	1.75	238	14.77	1.40
		Male	488	27.26	2.33	529	30.29	2.12
Belgium	General	Female	158	6.92	0.94	122	5.72	0.88
		Male	215	10.53	1.11	172	8.32	0.91
	VET oriented	Female	367	23.02	2.20	348	21.07	1.63
		Male	624	32.43	2.06	672	33.69	1.97
France	General	Female	203	10.34	1.20	225	11.42	1.10
		Male	253	14.38	1.21	391	21.95	1.28
	VET oriented	Female	51	18.80	5.54	61	22.94	4.50
		Male	95	24.81	3.67	155	41.53	4.23
Hungary	General	Female	387	20.12	1.65	124	8.58	1.02
		Male	449	29.44	1.82	278	19.93	1.74
	VET oriented	Female	222	81.54	4.43	143	52.43	5.78
		Male	343	80.61	4.35	251	58.40	6.43
Italy	General	Female	74	5.28	0.89	82	5.87	1.04
		Male	69	10.16	2.26	94	13.57	2.19
	VET oriented	Female	238	21.33	3.58	249	22.74	3.09
		Male	543	24.77	2.76	733	35.29	3.14
Portugal	General	Female	329	12.04	1.34	244	9.12	1.20
		Male	426	16.61	1.50	464	18.27	1.51
	VET oriented	Female	131	39.05	4.95	134	37.19	4.71
		Male	249	46.64	4.37	294	51.23	3.80
Slovak Republic	General	Female	242	17.51	1.53	275	20.27	2.04
		Male	336	24.44	1.74	460	33.33	1.98
	VET oriented	Female	77	70.38	10.01	82	73.57	8.10
		Male	162	56.77	6.08	190	70.34	5.66
Slovenia	General	Female	62	5.56	1.13	31	3.30	1.05
		Male	74	11.34	1.94	71	11.47	1.98
	VET oriented	Female	535	32.45	1.42	392	20.96	1.16
		Male	1,197	45.51	1.29	1,161	43.10	1.17

Table 6. PISA index of economic, social and cultural status (ESCS) for students in general and VET oriented programmes

	General	VET oriented
Australia	0.27	0.06
Austria	0.42	-0.08
Belgium	0.41	-0.20
France	0.02	-0.38
Hungary	-0.14	-0.95
Italy	0.29	-0.32
Portugal	-0.36	-1.12
Slovak Republic	-0.11	-0.65
Slovenia	0.41	-0.24

Table 7. Percentage of students in general and VET programmes of study without access to computers at home

	General		VET oriented	
	%	**N**	**%**	**N**
Australia	2.06	368	3.55	89
Austria	1.56	21	1.81	61
Belgium	2.04	89	4.44	145
France	2.49	94	7.02	44
Hungary	5.04	157	11.52	76
Italy	1.88	42	4.75	147
Portugal	2.52	116	6.37	43
Slovak Republic	10.26	273	8.71	34
Slovenia	1.17	17	1.78	79

Table 8. Percentage of students in general and VET programmes of study with access to internet at school but not at home

	General		VET oriented	
	%	**N**	**%**	**N**
Australia	2.09	389	3.46	77
Austria	0.65	8	0.65	23
Belgium	0.51	19	1.16	33
Hungary	3.67	120	7.95	49
Italy	1.00	29	2.94	83
Portugal	3.01	140	5.61	49
Slovak Republic	4.38	119	6.10	20
Slovenia	0.33	8	1.66	75

Table 9. Percentage of students who reported browsing the internet for schoolwork at school in general and VET programmes of study at least once a week

Country	Study orientation	%	% SE	N
Australia	General	80.89	0.58	9557
	VET oriented	80.5	1.57	1241
Austria	General	34.47	2.02	431
	VET oriented	53.87	1.51	1684
Belgium	General	22	0.95	1022
	VET oriented	40.07	1.41	1250
Hungary	General	34.32	1.20	1288
	VET oriented	43.95	2.99	285
Italy	General	20.25	1.2	480
	VET oriented	38.81	2.05	1077
Portugal	General	33.49	1.04	1598
	VET oriented	63.21	2.52	532
Slovak Republic	General	40.54	1.59	1126
	VET oriented	30.56	3.05	107
Slovenia	General	41.11	1.35	872
	VET oriented	42.47	0.86	1544

Table 10. Percentage of students who reported practicing and drilling at school in general and VET programmes of study at least once a week

Country	Study orientation	%	% SE	N
Australia	General	17.67	0.5	2111
	VET oriented	14.24	1.07	223
Austria	General	12.45	0.95	153
	VET oriented	14.96	0.97	476
Belgium	General	9.46	0.67	403
	VET oriented	19.07	0.94	587
Hungary	General	16.08	0.85	595
	VET oriented	25.78	2.10	162
Italy	General	16.96	1.18	398
	VET oriented	32.52	1.78	873
Portugal	General	12.63	0.64	628
	VET oriented	28.47	1.81	250
Slovak Republic	General	23.91	1.25	642
	VET oriented	27.24	2.26	86
Slovenia	General	15.83	0.88	345
	VET oriented	23.99	0.9	928

Table 11. ICT use at school of students in general and VET oriented programmes[18]

		Chat on line at school	Use email at school	Browsing the internet for school work	Practice and drill
Australia	General	14.66	48.63	80.89	17.67
	VET oriented	16.86	45.27	80.50	14.24
Austria	General	15.72	11.43	34.47	12.45
	VET oriented	29.09	26.51	53.87	14.96
Belgium	General	4.86	10.32	22.00	9.46
	VET oriented	12.92	18.33	40.07	19.07
Hungary	General	21.63	16.12	34.32	16.08
	VET oriented	39.53	29.78	43.95	25.78
Italy	General	7.31	5.59	20.25	16.96
	VET oriented	15.14	14.70	38.81	32.52
Portugal	General	12.51	21.35	33.49	12.63
	VET oriented	33.66	49.07	63.21	28.47
Slovak Republic	General	24.60	24.15	40.54	23.91
	VET oriented	32.21	26.22	30.56	27.24
Slovenia	General	17.64	24.03	41.11	15.83
	VET oriented	31.35	32.80	42.47	23.99

[18] Percentage of students that reported using ICT at school at least once a week.

Table 12. ICT use for entertainment for students in general and VET oriented programmes

	General	VET oriented
Australia	-0.12	-0.11
Austria	-0.14	-0.02
Belgium	-0.02	0.07
Hungary	0.31	0.33
Italy	0.10	0.09
Portugal	0.18	0.27
Slovak Republic	0.20	0.02
Slovenia	0.15	0.26

Table 13. ICT use at Home for school related tasks for students in general and VET oriented programmes

	General	VET oriented
Australia	0.25	0.00
Austria	0.03	-0.03
Belgium	0.00	-0.10
Hungary	0.13	-0.04
Italy	-0.05	-0.19
Portugal	0.30	0.33
Slovak Republic	0.04	-0.04
Slovenia	0.39	0.38

Table 14. School mean of students´ ESCS by orientation of study

	General	VET oriented
Australia	0.26	0.10
Austria	0.41	-0.08
Belgium	0.37	-0.16
France	0.01	-0.33
Hungary	-0.14	-0.95
Italy	0.28	-0.32
Portugal	-0.42	-0.81
Slovak Republic	-0.11	-0.57
Slovenia	0.41	-0.24

Table 15. Percentage of students attending rural schools by orientation of study

	General		VET oriented	
	%	**N**	**%**	**N**
Australia	5.48	918	9.66	173
Austria	8.34	123	10.42	314
Belgium	1.53	68	4.13	138
France	5.63	202	10.71	71
Hungary	2.84	67	3.11	11
Italy	0.16	3	6.75	171
Portugal	5.90	215	6.14	42
Slovak Republic	20.64	472	0.00	0
Slovenia	1.98	9	0.43	27

Table 16. School proportion of VET students by orientation of study

	General	VET oriented
Australia	0.08	0.33
Austria	0.00	1.00
Belgium	0.14	0.82
France	0.06	0.66
Hungary	0.00	1.00
Italy	0.01	0.99
Portugal	0.11	0.43
Slovak Republic	0.00	0.59
Slovenia	0.00	1.00

Table 17. ICT availability at school by orientation of study

	General	**VET oriented**
Australia	0.75	0.78
Austria	-0.11	0.18
Belgium	-0.51	-0.09
Hungary	-0.15	-0.05
Italy	-0.66	-0.05
Portugal	0.09	0.43
Slovak Republic	-0.02	-0.03
Slovenia	-0.32	-0.23

Table 18. Ratio of computers for education and the number of computers Adjusted by ESCS, by orientation of study

	General	VET oriented
Australia	1.51	1.57
Austria	1.63	1.19
Belgium	0.49	0.84
France	0.48	0.87
Hungary	0.53	0.39
Italy	0.39	0.59
Portugal	0.30	0.38
Slovak Republic	0.60	0.49
Slovenia	0.56	0.66

Table 19. Overall Browsing activity by orientation of study

	General	VET oriented
Australia	49.01	42.59
Austria	48.93	45.08
Belgium	50.92	40.23
France	52.61	42.95
Hungary	38.31	16.07
Italy	60.36	52.79
Portugal	46.95	34.39
Slovak Republic	44.75	23.95
Slovenia	49.25	31.15

Table 20. Task-oriented browsing by orientation of study

	General	VET oriented
Australia	58.23	54.97
Austria	54.19	44.88
Belgium	56.94	42.25
France	55.07	45.98
Hungary	43.67	23.19
Italy	54.68	43.36
Portugal	52.14	40.30
Slovak Republic	42.33	25.19
Slovenia	55.83	37.54

Table 21.1. Explained variation in the digital reading performance in general programmes[19]

General				
	Variation in digital reading performance explained by print-reading performance	Residual variation explained by the quantity of navigation steps (overall browsing activity)	Residual variation uniquely explained by the quality of navigation (task-oriented browsing)	Unexplained variation
Australia	72.1	3.0	3.2	21.6
Austria	61.7	13.7	15.2	9.3
Belgium	62.0	7.2	6.8	23.9
France	65.2	6.4	5.4	22.9
Hungary	65.9	7.3	7	19.8
Italy	52.6	7.4	7.9	32.0
Portugal	52.6	11.3	11.4	24.7
Slovak Republic	74.9	3.1	3.2	18.8
Slovenia	62.0	9.5	9.7	18.8

Table 21.2. Explained variation in the digital reading performance in VET programmes[1]

VET oriented				
	Variation in digital reading performance explained by print-reading performance	Residual variation explained by the quantity of navigation steps (overall browsing activity)	Residual variation uniquely explained by the quality of navigation (task-oriented browsing)	Unexplained variation
Australia	63.3	6.9	6.4	23.4
Austria	60.5	5.7	4.2	29.6
Belgium	55.2	11.2	10.9	22.7
France	65.5	7.6	4.7	22.2
Hungary	37.9	15.8	13.3	33
Italy	44.2	13.4	10.8	31.6
Portugal	56.5	15.0	14.3	14.1
Slovak Republic	44.2	13.9	10.5	31.4
Slovenia	56.3	7.0	5.4	31.3

[19] The figure is based on results from regressions of countries' mean performance in digital reading on mean performance in print reading and average values for the two indices of navigation.

Annex B

Table 1. Proportion of variance of students' digital skills

	Proportion of variability	General	VET oriented
Australia	Between schools	0.37	0.37
	Between students	0.63	0.63
Austria	Between schools	0.81	0.55
	Between students	0.19	0.45
Belgium	Between schools	0.59	0.46
	Between students	0.41	0.54
Hungary	Between schools	0.69	0.48
	Between students	0.31	0.52
Italy	Between schools	0.57	0.44
	Between students	0.43	0.56
Portugal	Between schools	0.44	0.49
	Between students	0.56	0.51
Slovak Republic	Between schools	0.5	0.34
	Between students	0.5	0.66
Slovenia	Between schools	0.5	0.6
	Between students	0.5	0.39

Table 2. Multilevel coefficients for the relationship between student and school characteristics students' digital skills

Digital Reading	**NULL**		**FINAL**		**NULL**		**FINAL**	
	Australia General	Australia VET	Australia General	Australia VET	EU7 General	EU7 VET	EU7 General	EU7 VET
Fixed Part (constant)	509.722	483.216	99.368	81.021	487.445	430,315	134.415	147.328
Students characteristics								
Print reading score			**0.75**** (0.01)	**0.761**** (0.03)			**0.661**** (0.01)	**0.625**** (0.01)
Gender (Ref:female)			-1.322 (1.30)	-5.26 (3.95)			**4.139**** (1.18)	**3.321*** (1.71)
Non-immigrant background			**4.92**** (1.56)	9.178 (5.22)			**8.6**** (2.34)	**5.014**** (2.50)
ESCS (Socio-economic Status)			-1.295 (0.91)	0.121 (2.78)			**3.723**** (0.72)	-0.773 (0.98)
Students ICT availability at Home			1.177 (0.84)	0.321 (2.53)			-0.534 (0.72)	**-2.631**** (0.81)
Practicing and drilling at school			-2.081 (1.61)	-2.229 (5.74)			**-3.349*** (1.73)	-0.909 (1.88)
Browsing the internet for school work at school			**4.887**** (1.68)	0.437 (5.11)			-0.798 (1.39)	**2.797*** (1.68)
Chatting on line at school			**-4.538**** (1.83)	7.884 (5.54)			-1.101 (1.85)	-2.316 (2.01)
Using email at school			1.588 (1.46)	-1.477 (4.47)			1.607 (1.84)	1.668 (2.05)
Overall browsing activity			**0.32**** (0.03)	**0.461**** (0.09)			**0.287**** (0.03)	**0.408**** (0.03)
Task-oriented browsing			**0.297**** (0.03)	**0.415**** (0.086)			**0.319**** (0.02)	**0.387**** (0.03)
ICT entertainment use			**1.816**** (0.80)	3.747 (2.41)			**3.199**** (0.68)	**6.09**** (0.78)
ICT use at home for school related tasks			**1.669**** (0.82)	1.229 (2.25)			**-1.254*** (0.72)	**-4.706**** (0.8)

Table 2. Multilevel coefficients for the relationship between student and school characteristics students' digital skills (cont.)

Digital Reading	**NULL**		**FINAL**		**NULL**		**FINAL**	
	Australia General	Australia VET	Australia General	Australia VET	EU7 General	EU7 VET	EU7 General	EU7 VET
School characteristics								
School average of students' ESCS			**9.661**** (3.22)	10.928 (7.19)			**19.093*** (2.26)	**29.106*** (4.37)
ICT availability at school			-1.387 (1.06)	-1.618 (3.133)			-0.595 (0.642)	0.179 (0.73)
Rural school (school location)			**-12.027*** (4.72)	**-20.774*** (9.17)			-0.495 (4.61)	-10.068 (6.85)
School proportion of VET oriented students			-13.122 (9.2)	-2.737 (15.14)			12.7 (9.28)	7.641 (8.54)
Random Part (School level)	3822.109	3962.394	919.706	1015.583	6716.924	5647.516	777.879	1015.306
Random Part (Student level)	6600.569	6515.217	1232.748	1255.942	3955.832	4275.579	1491.376	1523.277
Deviance	149467.2	20603.94	43769.36	5626.837	257373	179440.6	58812.11	38675.14

Notes:
Country dummy variables were used for the EU7 aggregated analysis.
* $p < 0.1$ ** $p < 0.05$. Standard errors in parentheses.

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